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SCIENCE 7

MODULE 5:
MICRO-ORGANISMS AND FOOD SUPPLIES

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Science 7

Module 5

MICRO-ORGANISMS AND FOOD SUPPLIES

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Student Module
Module 5
Micro-organisms and Food Supplies
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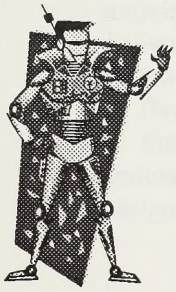


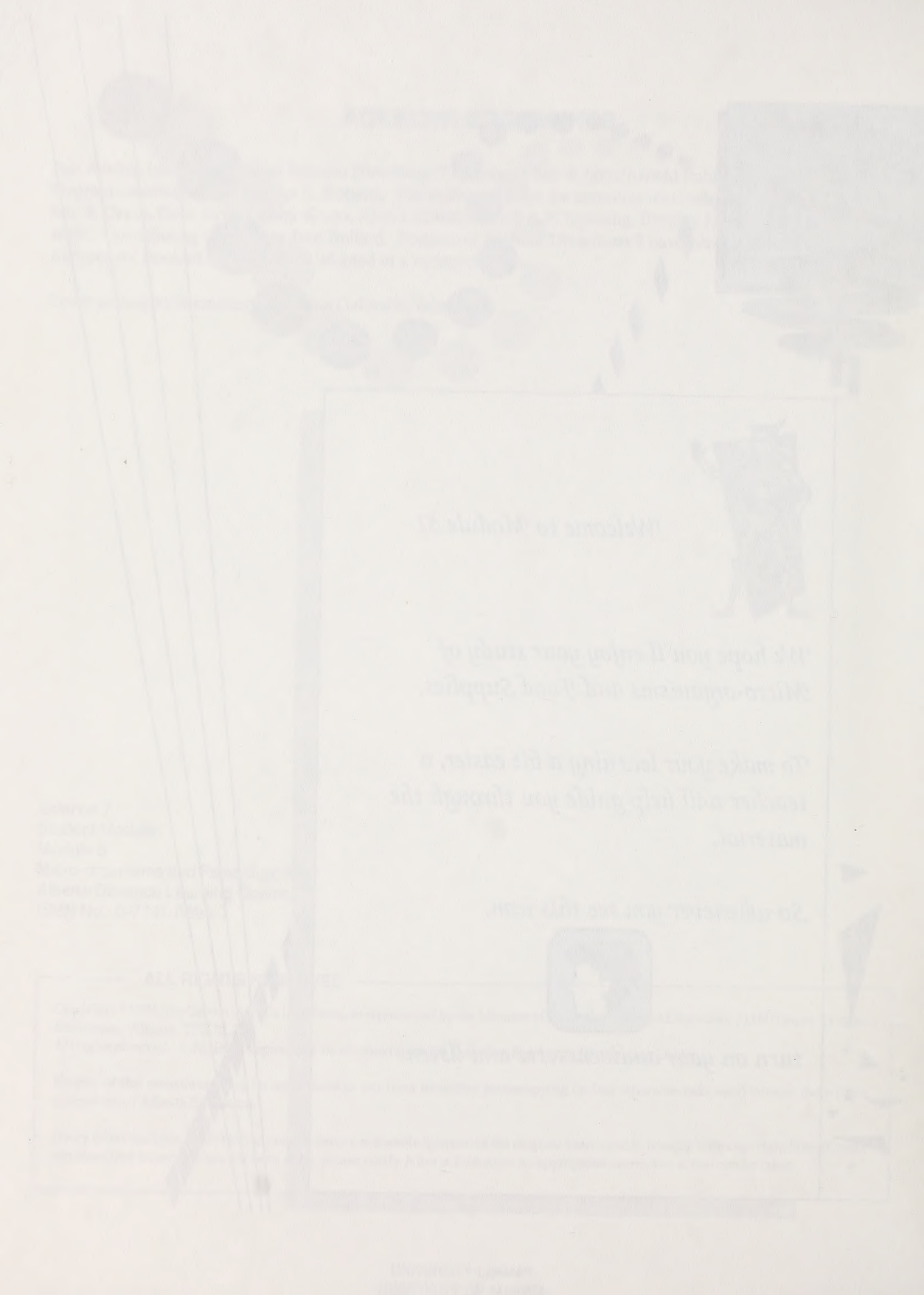
Welcome to Module 5!

We hope you'll enjoy your study of Micro-organisms and Food Supplies.

To make your learning a bit easier, a teacher will help guide you through the material.

So whenever you see this icon,

turn on your audiocassette and listen.



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7
Science Directions

OVERVIEW

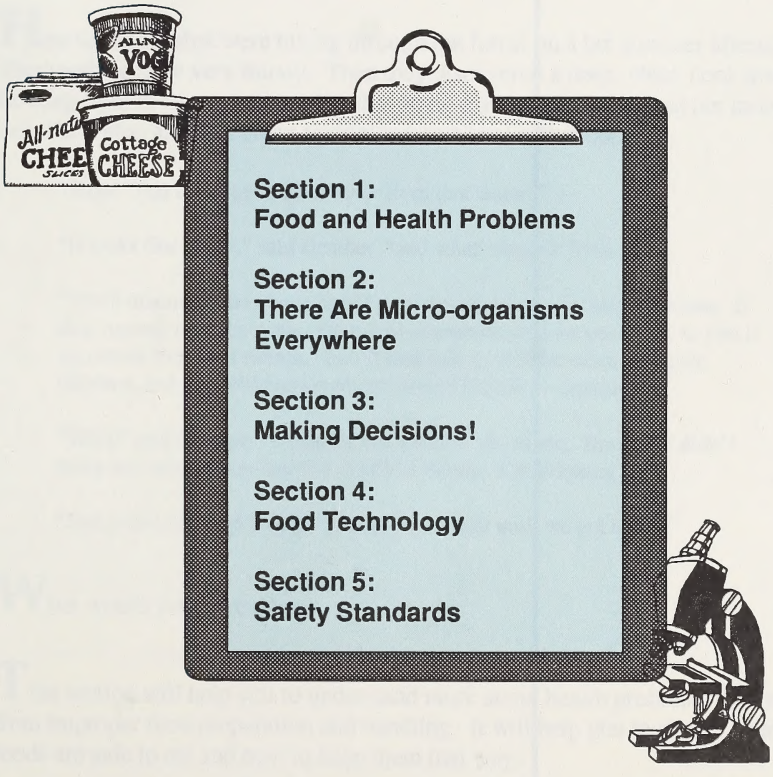
Turn to pages 250 and 251 of your textbook, *Science Directions 7*. Read the information given on page 250 and examine the accompanying photographs. The information on these pages provides an introduction to some of the things you will study in this module.

How do you know that food is safe? What are the dangers and how are they avoided? What should you know about micro-organisms?

In this module you will learn

- what health problems result from improper food preparation and handling
- what micro-organisms are and where they live
- how micro-organisms affect your food
- how your food can be kept safe from micro-organisms
- how society makes decisions about safe handling of food

Micro-organisms and Food Supplies



Section 1:
Food and Health Problems

Section 2:
There Are Micro-organisms Everywhere

Section 3:
Making Decisions!

Section 4:
Food Technology

Section 5:
Safety Standards

Evaluation

Your mark in this module will be determined by your work in the Assignment Booklet. You must complete all assignments. In this module you are expected to complete four section assignments.

The assignment breakdown is as follows:

Section 1 Assignment	**0%**
Section 2 Assignment	**31%**
Section 3 Assignment	**21%**
Section 4 Assignment	**26%**
Section 5 Assignment	**22%**
TOTAL	**100%**

Note: There is no assignment for Section 1.

Section

1

Food and Health Problems

Heather and Nabat were hiking through the forest on a hot summer afternoon. They both became very thirsty. Then they discovered a deep, clear, cool stream flowing right in front of them. Heather immediately bent down, put her mouth near the water, and was about to drink when Nabat called out:

"Stop! You could get beaver fever from that water!"

"It looks fine to me," said Heather, "and what's beaver fever?"

"Small mammals may have harmful micro-organisms in their intestines. If they excrete near the water, the micro-organisms may be passed on to you if you drink from that stream. You'll feel sick to your stomach and have diarrhea, and you will need medicine to kill the micro-organisms."

"Well," said Heather, "it sounds like a lot of 'ifs' to me. Besides, I didn't bring any other water with me, and I'm thirsty. I'm drinking it."

"Suit yourself," said Nabat. "I'm going to wait until we get home."

What would you have done?

This section will help you to understand more about health problems that result from improper food preparation and handling. It will help you to decide what foods are safe to eat and how to keep them that way.

Activity 1: Micro-organisms and Health Problems

An Introduction to Micro-organisms

Micro-organism: an organism that is too small to be seen without a microscope

There are many different kinds of **micro-organisms** to be found in the world, all of which are too small to be seen by the unaided eye. Most of these play roles that go unnoticed and unseen in your life. Other micro-organisms affect you so directly that it is important for you to study them and be aware of their presence. As you probably already know, some micro-organisms can be quite harmful, even deadly, if they are not treated with care. Others are quite harmless and are a normal part of the natural world. A few are particularly helpful to humans and are used in a variety of ways.

As a start to the study of micro-orgamisms, this section will examine some of the ones that cause the most concern. In this activity you will be looking at micro-organisms that cause disease and especially the ones that may be carried on food. In later activities in this section, you will look at the variety of micro-organisms that play other roles in the world around you. You will look at some of the ones that help you, including those that help in the preparation of food. You will even consider some that play a helpful role in your own body.

Did you know that you come into contact with billions of micro-organisms every day? "How did I meet these creatures?" you might ask. "Were they friendly or were they unfriendly? Will I notice them?" Probably you won't notice them, because most won't affect you one way or the other. But some micro-organisms that you meet may be very unfriendly. The ones that will be described to you on the next few pages are among the unfriendliest of them all.

Looking after yourself involves making sure that you know about such micro-organisms. The knowledge that you gain by studying them helps assure you of your own health and safety.

Health Problems

Viruses: extremely small organisms that grow and multiply only when in a living cell; the singular form is virus

Bacteria: one type of micro-organism that can be round, spiral, or rod shaped; the singular form is bacterium Some bacteria can cause disease while others are helpful.

Many health problems are caused by **viruses** and **bacteria**. Bacteria are micro-organisms – living things that are too small to be seen without a microscope. Viruses are so small that they are only seen under a high-power microscope. Micro-organisms are found in a variety of environments and unless you take precautions, they can get into your food and into your body. If certain kinds of micro-organisms get into your body, they can cause serious illnesses.

The Health Problems chart which follows describes how some micro-organisms might get into your body and cause disease. The chart describes several ways you can catch a kind of flu that causes nausea and diarrhea. It also explains how you can get the more common types of **food poisoning**.

Food poisoning: several kinds of sickness caused by eating food containing certain kinds of harmful micro-organisms

Health Problems

Health Problem	Descriptions of the Problem
viral flu (gastroenteritis)	• Viral flu is caused by a particular kind of virus found in the air or on objects. • The virus can be transferred from hands to the mouth to the intestine where it multiplies. • If someone who has the virus coughs or sneezes, the virus can be spread to food or in the air. • Other people may breathe the air infected by the virus, or they may touch objects which have the virus on them. • When using the bathroom, hands may touch excrement or urine. If the hands are not washed properly, they can transfer the virus to food or other people.
bacterial flu (gastroenteritis)	• Bacterial flu is caused by a particular type of bacteria found in soil, poultry, and some wild animals. • If meat is left in a warm, moist place with oxygen (from air), the bacteria multiply. • If someone eats this food, they will get the bacteria, which continue to multiply, and make them ill. • The bacteria can be passed to others by coughing or not washing hands properly (with soap) after using the bathroom.
salmonella poisoning	• Several different kinds of salmonella bacteria are found in poultry, eggs, and dairy products. • If these foods are left for a period of time in warm, moist conditions with oxygen, the bacteria will multiply. • If someone eats the food, they may or may not become ill. They may still transfer the bacteria to others by coughing or not washing hands properly.

Salmonella: a type of bacteria that can cause food poisoning in humans

1. Name two types of micro-organisms that cause many health problems.

   • _____

   • _____

2. When micro-organisms multiply on food, the increased number of micro-organisms can make the food unsafe to eat. Search the Health Problems chart for information about what conditions help micro-organisms multiply. List three conditions that help bacteria to multiply quickly.

   - _____
   - _____
   - _____

3. In the Health Problems chart you should have noticed a few hints on how to handle food safely. What are some precautions that should be taken when handling food to reduce the risk of spreading micro-organisms which could cause disease?

   _____

   _____

   _____

Check your answers with your learning facilitator.

Activity 2: Proper Food Packaging

Even if you follow all of the suggestions you stated in your answer to question 3 in Activity 1, micro-organisms from the air can still multiply on food and make it unsafe to eat.

Today, as in the past, people have developed ways to slow down the rate at which micro-organisms multiply on stored food. Storing food in special ways allows you to keep food to use whenever you choose. This means that you can eat fruit and vegetables all year long, not just during the growing season. Fish do not have to be eaten the same day that they are caught, and you do not have to keep live chickens in your backyard. Think about how your life would be different if you did not have a refrigerator to keep food cold!

Turn to page 281 of *Science Directions 7*. The pictures on that page show some of the familiar ways foods are processed and packaged. Each of the methods shown discourages spoilage by changing at least one factor that micro-organisms need to multiply. In each case micro-organisms have been deprived of one or more of the factors needed to multiply.

Most micro-organisms spread and grow best on food that is moist and warm. If the food has no micro-organisms to start with, the packaging can keep micro-organisms out by keeping them from the food.

Refer to the illustration on page 281 of the textbook to answer the following questions.

1. Which of the ways of packaging and storing food shown deprives micro-organisms of moisture?

   _____

   _____

2. Which of the ways of packaging and storing food shown deprives micro-organisms of warmth?

   _____

   _____

3. Which of the ways of packaging and storing food shown helps keep micro-organisms from contacting the food?

   _____

   _____

Check your answers with your learning facilitator.

Activity 3: Planning a Meal

Another way that you can use the information in the Health Problems chart from Activity 1 is for planning a safe way to prepare food for a meal. You must be more careful with some types of food than with others. Once you have removed food from its special storage conditions, you are responsible for keeping it safe. Keeping it safe means slowing down the rate at which micro-organisms multiply.

This activity will help you think about how to prepare food safely for your friends.

You have invited some of your friends over for a meal on a warm summer day. They are to arrive about 5 p.m. You have to prepare at least some of the food in the morning because you are busy all afternoon.

Here is your menu:

- chicken noodle soup (from a can)
- egg salad sandwiches (bread, butter, mayonnaise, onion, eggs)
- potato chips
- fresh fruit salad with whipped cream
- milk

1. Which two foods are quickest to get ready and can be left until just before serving time?

_____

_____

2. Which two foods will take time to prepare and may need to be prepared in the morning?

_____

_____

3. How would you keep the following foods from growing micro-organisms if you had to prepare them well before 5 p.m.?

   a. egg salad sandwich

   _____

   _____

   b. potato chips

   _____

   _____

   c. fresh fruit salad

   _____

   _____

d. whipped cream

_____

_____

e. milk

_____

_____

Activity 4: Keeping Food Safe to Eat

Perishable: likely to spoil or decay

Decay: to become rotten

Spoil: to become infected by decay or disease

Food does not last forever. It is **perishable**. At some point in time it begins to **decay**. To protect food so that it does not **spoil**, micro-organisms must be kept out of it, or if there are micro-organisms already in the food, then the micro-organisms need to be killed or have their growth rate greatly reduced. Food safety standards have now been developed to help ensure a safe supply of food, but food safety standards have not always been in place.

Micro-organisms need moisture, warmth, and oxygen to grow. If one or more of these conditions that promote growth of micro-organisms is eliminated, then food can be kept from spoiling. In Activity 2 you looked at how packaging, canning, and freezing, which are fairly recent methods of preserving food, can discourage micro-organisms from growing in food. More traditional methods of preserving food, such as the use of cold temperatures, fermenting, and drying, also deprive micro-organisms of at least one condition they need to grow.

7 Science Directions

Now read pages 281 to 283 of *Science Directions 7* for more information on how the food preservation methods just mentioned help keep food safe to eat.

In this activity you will try one of the traditional methods of food preservation.

Do either Part A or Part B, or do both Part A and Part B.

Part A involves using salt to dry food out and then answering questions 1 to 3.

Part B involves drying apples in an oven and then answering questions 4 to 6.

Part A

Coating foods with salt results in water being removed from the food. Other materials also flow out of the food with the water and combine with the salt. This procedure, along with proper drying of the food, helps to prevent food from spoiling. This method of preventing food spoilage is called curing.

Pickling helps prevent food from spoiling in a similar way. In this method, food is placed in a pickling solution containing salt, vinegar, sugar, and spices. Water and other materials flow out of the food and mix with the pickling solution and help to prevent the food from spoiling. This process is used for pickling foods such as vegetables, eggs, and fish.

Materials You Need

- salt
- two slices of potato about 1 cm thick
- two slices of apple about 1 cm thick
- four jars or glasses to set the food into
- lids or plastic wrap
- labels or grease pencil
- measuring spoon

Steps to Follow

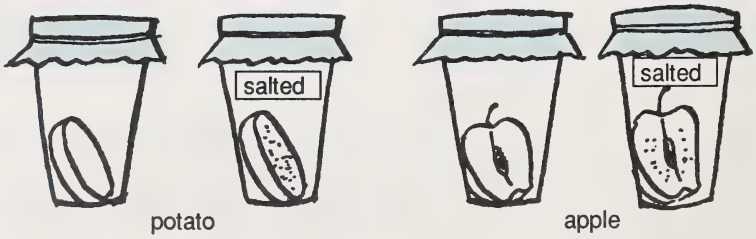
Step 1: Place each slice of potato and apple in a separate jar or glass – four in total.

Step 2: Sprinkle 5 mL of salt on **one** of the potato slices.

Step 3: Sprinkle 5 mL of salt on **one** of the apple slices.

Step 4: Don't do anything to the other apple and potato slices.

Step 5: Label the containers as shown in the diagram.



Step 6: Cover every container with a lid or plastic wrap.

Step 7: Record your observations for the stated times in the observations chart.

Observations

	0 minutes	15 minutes	1 hour	1 day
potato – no salt				
potato – salt				
apple – no salt				
apple – salt				

Questions to Answer

1. What happened to the salted slices?

_____

_____

2. What happened to the unsalted slices (the control)?

_____

_____

3. a. Does just salting food prevent micro-organisms from multiplying in it?

_____

_____

b. Explain.

_____

_____

_____

Check your answers with your learning facilitator.

Part B

Drying food removes the water. Most foods need very special conditions of moisture, temperature, and air flowing around them to be dried properly. Drying fish and meat can be very dangerous if not done correctly.

4. What do you think the danger might be?

_____

_____

_____

In Part B you will dry apples in an oven.

Materials You Need

- a stove with an oven
- two or three apples
- knife
- cake cooling wire rack
- cookie sheet
- ascorbic acid
- cup of cold water
- measuring spoon
- bowl

Steps to Follow

Step 1: Wash your hands; then rinse the apples.

Step 2: Peel and core the apples.

Step 3: Cut them into slices about 0.5 cm thick.

Step 4: Put 1 mL of ascorbic acid into a cup of cold water. Pour into a bowl.

Step 5: Let the apple slices soak in the water for about 10 minutes. This keeps the apple from turning brown when in contact with the air.

Step 6: Place the slices on a wire cake rack, and set the rack on a cookie sheet.

Step 7: Ask an adult to place this in an oven at about 60°C (140°F).

Step 8: Leave the apples until they are soft and leathery (3 to 6 hours). No moisture should come out if the slices are cut and pressed.

Questions to Answer

5. How long were the apples left in the oven?

_____

_____

6. Describe the appearance of the apple slices after taking them out of the oven.

_____

_____

7. How do you think the drying helps prevent micro-organisms from growing on the food?

_____

_____

Check your answers with your learning facilitator.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

Extra Help

Micro-organisms are living things that are too small to be seen without a microscope. Viruses and bacteria are two types of micro-organisms.

Micro-organisms are found in a variety of environments and unless you take certain precautions, they can get into your food and then into your body. If certain micro-organisms get into your body, they can cause sickness or perhaps even death.

Search the Health Problems chart given in Activity 2 for information to answer the following questions.

1. List two places where a virus can be found.

   - _____
   - _____

2. List three places where salmonella bacteria can be found.

   - _____
   - _____
   - _____

3. What are two ways that bacteria and viruses can get into your body?

   - _____
   - _____

4. What will happen to you if these bacteria and viruses get into your body?

   _____

   _____

   _____

5. Why is it important for you to wash your hands after using the bathroom?

_____

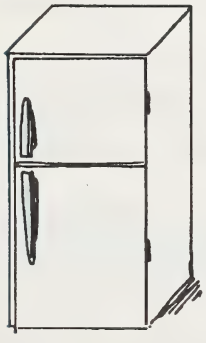
_____

_____

If micro-organisms get into your food, they can grow and multiply if the conditions are right. For many types of bacteria, the best conditions for growth are

- warmth
- moisture
- oxygen from the air

6. Compare the following situations. Which will allow micro-organisms to multiply, and which will prevent micro-organisms from multiplying? Give reasons for your answers.



a. food kept in a refrigerator

_____

_____

_____

_____

_____

_____

b. food left out on a table

_____

_____

_____

_____

_____

_____

7. Compare the following situations. Which will allow micro-organisms to multiply, and which will prevent micro-organisms from multiplying? Give reasons for your answers.

a. food kept in a jar with a tightly sealed lid

b. food in a jar with the lid off

8. a. Raisins are dried grapes. Raisins can be bought in cardboard boxes and will remain safe to eat for a few weeks without refrigeration. Would grapes be safe if they were stored in the same way?

b. Give reasons for your answer.

9. Beef jerky is made of strips of beef meat that have been dried, salted, and flavoured. In many stores, beef jerky is kept in a jar at the sales counter, but beef meat is kept well wrapped and in a freezer. Why is beef jerky so much easier to store?

_____

_____

_____

Check your answers with your learning facilitator.

Enrichment

1. a. In the following chart, list six foods you would like to take for your lunch at school.

   b. Assume your lunch sat in your locker over the weekend. Opposite the list of foods, write *yes* if you think the food would be safe for you to eat on Monday. Write *no* if you think the food would not be safe to eat. (Use the Health Problems chart to help you with your answers.)

Name of Food	Yes or No
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

c. Explain why each food in the chart would or would not be safe to eat.

- _____
  _____
- _____
  _____
- _____
  _____
- _____
  _____
- _____
  _____
- _____
  _____

Conclusion

You have learned about some health problems that result if foods are not handled safely. You should understand how to prevent some of these problems. You have also learned about traditional methods developed to keep food from spoiling. Harmful micro-organisms grow on foods if conditions are right. Just what are these micro-organisms? You will find out more about them in the next section.

Assignment Booklet

ASSIGNMENT

There is no assignment for Section 1. Proceed to Section 2.

Section

2

There Are Micro-organisms Everywhere

For as long as people have been eating, they have realized that some foods could make them very ill or cause death. Foods that changed colour, texture, or had a bad smell were obvious ones to avoid. Gradually societies learned how to prevent some of these changes. You learned about some of the more common methods in Section 1. But people still didn't understand the real cause of food spoilage.

About 300 years ago it was discovered that lenses could magnify very small objects. Anton van Leeuwenhoek was the first person to use lenses to observe tiny living creatures. He used his lenses to make the first simple microscope. Some of the tiny plants and animals discovered were found to be living on foods. Experiments showed that these micro-organisms cause food to spoil.

With more powerful microscopes much more detailed information about micro-organisms has been obtained. In this section you will learn what some micro-organisms look like, where they are found, and what conditions are needed in order for them to grow.

Activity 1: Looking at Micro-organisms

7 Science Directions

To begin this activity read How Micro-organisms Were Discovered on pages 252 and 253 of *Science Directions 7*. Find out how Anton van Leeuwenhoek's achievements have enabled scientists to observe and compare various types of micro-organisms.

Many micro-organisms are made of just one cell. The single cell has all the characteristics of living things. If a micro-organism is made of one cell, it is called **unicellular**.

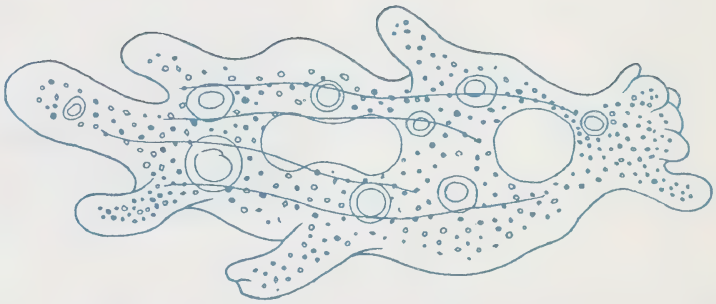
Unicellular: having only one cell

Several cells may be joined together. Micro-organisms made of more than one cell are called **multicellular**. These may take many different shapes. But each cell still performs all the functions of living things.

Multicellular: having more than one cell

Sometimes people find it difficult to accept the existence of micro-organisms since most micro-organisms are invisible to the naked eye. Many people have never seen micro-organisms in detail because they would need a **microscope** to do so. Micro-organisms are so much smaller than other living things that it is difficult to imagine their size.

Microscope: an instrument used to examine objects too small for the human eye to see clearly



A Micro-organism Magnified Many Times

Bacteria are measured in units called micrometres. One thousand micrometres equal 1 mm. But even as small as micro-organisms are there is a wide range of sizes among micro-organisms themselves!

Since van Leeuwenhoek's amazing discovery, scientists have observed many different types of micro-organisms. People now accept the fact that they are surrounded by great numbers of tiny living things that aren't normally seen. These different types of micro-organisms are now classified into five main groups based on their characteristics. In Section 1 you learned that bacteria and viruses form two groups of micro-organisms. The other main groups are **protozoa**, **algae**, and **fungi**. You do not have to classify micro-organisms in this module, but you should recognize that these five names all refer to tiny living things called micro-organisms.

Protozoa: single-celled organisms larger than bacteria; singular form is protozoan
Protozoa move by waving a whip-like structure, changing their shape, or beating hair-like structures.

Algae: unicellular micro-organisms that are plants; the singlular form is alga
Most algae are green, red, or brown.

Fungi: unicellular or multicellular micro-organisms that are plants; the singular form is fungus
Fungi range in size from microscopic to the size of mushrooms.

In this activity you will have your turn to look at some micro-organisms.

Do either Part A, Part B, or Part C.

Part A involves using a microscope to observe prepared slides of micro-organisms and answering questions 1 to 6.

Part B involves viewing a videocassette called *The Microscope and Its Incredible World* and answering questions 7 to 17.

Part C involves observing diagrams of micro-organisms and answering questions 18 to 23.

Part A

Note: You do not need to complete Part A if you wish to do Part B or Part C.

Materials You Need

- microscope
- prepared slides of micro-organisms
  - typical baccilus
  - typical coccus
  - yeast
- lens tissue

Caution

- Obtain permission from your learning facilitator to use a microscope, if one is available.
- See your learning facilitator for specific instructions on the care and handling of the particular model of microscope you are using.

Steps to Follow

Step 1: Compare your microscope with the diagram of the microscope shown on page 369 of *Science Directions 7*. Your microscope may look quite different from the one shown in the textbook, but the basic parts will likely work in much the same way.

Step 2: Carefully read the instructions on Getting to Know the Microscope and Hints for Handling a Microscope on pages 369 and 370 of the textbook.

Step 3: Use lens tissue to clean the eyepiece and objectives. Use a gentle circular motion.

Step 4: Clean your first slide with the tissue, and clip it onto the stage.

Step 5: If your microscope has only one objective lens, examine the object through the eyepiece and focus the microscope using the adjustment knob.

Step 6: If your microscope has three objective lenses and two knobs to adjust the focus, follow these hints.

a. Move the 4X objective over the slide, and focus with the coarse adjustment knob only. Try to keep both eyes open when viewing.

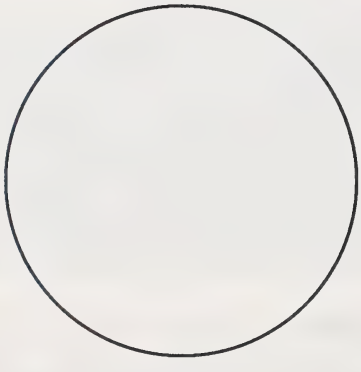
b. Without moving anything else, rotate the 10X objective over the slide and focus with the coarse adjustment knob only.

c. If the 40X objective will fit over the slide, focus with the fine adjustment knob only. If it won't fit, go back to the 10X objective.

Step 7: Use a pencil to draw the micro-organism carefully in the observation circles that follow and describe the shape of the cells.

Step 8: Repeat steps 4 to 7 with the remaining three slides.

Observations



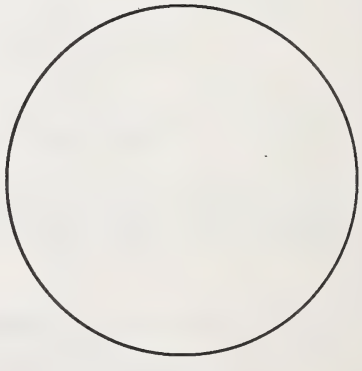
Typical Bacillus

overall shape: _____

_____

shape of each cell: _____

_____



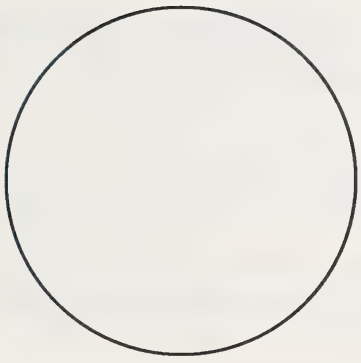
Typical Coccus

overall shape: _____

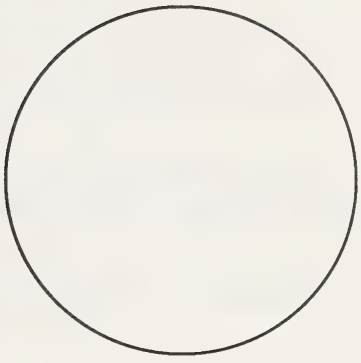
_____

shape of each cell: _____

_____



Spirillum



Yeast

overall shape: _____

_____

shape of each cell: _____

_____

overall shape: _____

_____

shape of each cell: _____

_____

Questions to Answer

Make the necessary interpretations to answer the following questions.

1. The eyepiece is a 10X eyepiece. Magnification using the 4X objective makes the object appear 40 times larger than it really is.

   The eyepiece magnifies by 10.

   The objective magnifies by 4.

   $10 \times 4 = 40$

   a. What would the magnification be using the 10X objective with the 10X eyepiece?

   _____

   b. What would the magnification be using the 40X objective with the 10X eyepiece?

   _____

2. The yeast cells you observed have the same general shape as one of the first three kinds of bacteria you examined. Which of the three do the yeast cells look most like?

_____

_____

3. Most of the bacteria found in food are like the bacillus or coccus that you observed. These may be helpful or harmful. How could you tell the difference between these two bacteria?

_____

_____

4. The yeast slide may show some of the yeast cells dividing. How do you think they do this?

_____

_____

5. Which of the slides showed the cells in groups or clumps?

_____

_____

6. What is the benefit to the micro-organism when it lives in food?

_____

_____

Check your answers with your learning facilitator.

Part B

Note: You do not need to complete Part B if you have already done Part A or if you wish to do Part C.

The videocassette *The Microscope and Its Incredible World* shows you how to use a microscope and what many small organisms and micro-organisms look like through a microscope.

View the videocassette (about 21 minutes long) and then answer the following questions.

7. Why is a microscope like two magnifying lenses?

_____

_____

_____

_____

8. If you combined a 10 power eyepiece with a 20 power objective, what would the overall power or magnification be?

_____

_____

9. Number the following steps of how to use a microscope in the order that you would do them.

_____ Place your eye directly above the eyepiece.

_____ Use the fine focus knob to bring the specimen into focus.

_____ Rotate the nosepiece so that the objective with the lowest power is directly above the stage hole.

_____ Place the slide on the stage beneath the stage clips.

_____ Turn the coarse focus knob slowly until the specimen comes into rough focus.

_____ Change to a higher power objective.

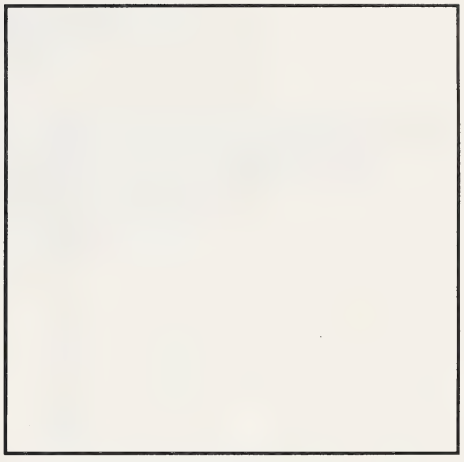
10. Describe or draw the shape of diatoms, the world's smallest plants. (These are shown a little after the insects in the videocassette. You may need to use the pause button to examine them closely.)

11. Estimate the number of protozoa in the one drop of pond water viewed through the microscope. Circle the number closest to your estimate.

    a. 10
    b. 100
    c. 1000

12. Describe or draw the shape of an *Amoeba*.

13. Describe or draw the shape of a *Paramecium*.



14. What are cilia (the hairlike structures on protozoa) used for?

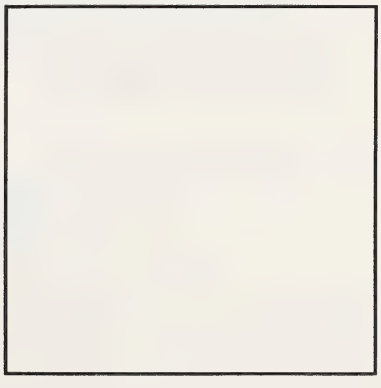
_____

_____

_____

_____

15. Colonies are groups of micro-organisms living together. Draw the shapes of two different colonies.



16. Describe or draw the shape of bacteria. (These are shown near the end of the videocassette.)

17. Why is the microscope referred to as "a passport to an incredible, new world"?

Check your answers with your learning facilitator.

Part C

How to Use a Microscope

Even though you may not have a microscope, you should become familiar with the proper use and care of a microscope before observing diagrams of micro-organisms. Study Using a Microscope on pages 368 to 370 of *Science Directions 7*. Answer the following questions.

7 Science Directions

18. What is a compound microscope?

_____

_____

_____

19. If the microscope has a low-power, medium-power, and a high-power objective lens, which would you use first to focus on an object?

_____

_____

_____

Observing Micro-organisms

Bacteria, viruses, algae, protozoa, and fungi are five types of micro-organisms you will study in Part C. Observe the photographs on pages 256 to 259 of *Science Directions 7*. Be sure to read the descriptions. Along with the characteristics, some interesting facts are given for each of the five types of micro-organisms in the textbook descriptions. Use the information from the textbook to answer the following questions.

7 Science Directions

20. Order the five types of micro-organisms from the one that is generally the largest to the one that is generally the smallest.

largest _____

_____

_____

_____

smallest _____

21. Which types of micro-organisms are unicellular?

_____

_____

_____

22. Which types of micro-organisms are multicellular?

_____

_____

_____

23. What is unusual about viruses?

_____

_____

_____

Check your answers with your learning facilitator.

Activity 2: Micro-organisms Are Everywhere

Think of a place on Earth where no one would be able to live for very long. Micro-organisms would probably be there. They live in oceans, deserts, and on mountain tops. They live in the soil and air and on plants and animals. They are all over your skin and hair, and they are all through your digestive tract. Some bacteria live in hot springs, and others live in snow and at the Polar Ice Caps.

For additional information about where micro-organisms live, read pages 260 and 261 of *Science Directions 7.*

Micro-organisms are everywhere, including food supplies. In some cases they help break down food. In other cases they may be used in food production. When your food begins to decay, it is because bacteria, fungi, and other micro-organisms are feeding on it. They are using your food as their food. Just like you, micro-organisms prefer certain foods. And just like you, they prefer certain conditions in which to eat and grow.

Yeast: a unicellular fungus that is used in making bread and alcohol

Yeast is a micro-organism involved in food production. In this activity you will look more closely at the conditions needed in order for it to grow. Yeast is a micro-organism (fungi) that many societies use to cause bread to rise. The yeast feeds on the sugar in the dough and changes it into gases and other chemicals. The gases expand into bubbles in the dough if it is warm. The bubbles are trapped in the sticky mixture. When the dough is baked it becomes firm around the gas bubbles, giving the finished bread a light texture.

Conditions necessary for yeast to multiply are

- food
- moisture
- warm temperature
- oxygen

By doing this activity you will see evidence of yeast multiplying.

Materials You Need

- tall glass jar (500 mL)
- ruler
- yeast
- measuring cup
- measuring spoon
- warm water
- 250 mL flour
- 10 mL sugar
- grease pencil
- large spoon
- large bowl

Steps to Follow

Step 1: Pour 250 mL of flour into the glass jar.

Step 2: Dissolve 10 mL of sugar in 200 mL of warm water.

Step 3: Stir 15 mL of yeast into the water.

Step 4: Let the sugar, water, and yeast stand for 5 minutes.

Step 5: Pour the yeast mixture into the flour. Stir with a large spoon until it is mixed.

Step 6: Try to level the dough in the bottom of the jar. Mark the level with the grease pencil.

Step 7: Measure the height of the grease pencil mark; then record it in the observations chart.

Step 8: Place the jar in a bowl of warm (not hot) water.

Step 9: Measure and record the new level of the dough in the observations chart every 10 minutes for 40 minutes.

Observations

Time (minutes)	Level of Dough (cm)
0	
10	
20	
30	
40	

Interpretations

1. What evidence was there that the yeast was multiplying?

_____

_____

_____

_____

2. What do you think you could do to slow down or stop the yeast from multiplying?

_____

_____

_____

_____

3. Fermentation is a slow chemical change that gives off bubbles of gas. How do you know that growing yeast is an example of fermentation?

_____

_____

_____

_____

Check your answers with your learning facilitator.

Activity 3: Controlling Micro-organisms

7 Science Directions

Turn to page 279 of *Science Directions 7*. One of the photographs at the bottom of the page shows bread being made in a bakery. When the dough is left in a warm place, bubbles of carbon dioxide produced by the yeast cause the dough to rise. Alcohol, also produced by the yeast, evaporates when the bread is baked.

In Activity 2 you used yeast and observed the conditions under which it multiplies. You may be able to hypothesize about how to change these conditions to make the yeast multiply faster or slower. If you then test your hypothesis, you will be doing what scientists do when they try to explain technologies used to process and preserve food. Knowing why methods for preparing and preserving food work helps people decide which methods are safer than others.

During this activity, you will try to control the rate at which yeast multiplies.

Experimental Design

1. List three things you could do that might make the bread dough rise more quickly.

   - _____
   - _____
   - _____

2. List three things you could do that might prevent the yeast from multiplying or slow down the rate at which the yeast multiplies.

   - _____
   - _____
   - _____

3. Choose one of the conditions (variables) from your answer to question 1 or 2 that you wish to test.

   a. Which variable are you going to test?

   _____

   b. Do you expect this variable will make the dough rise more quickly or more slowly?

   _____

Materials You Need

4. List the materials you will use to test your variable.

   - _____ amount of flour
   - _____ type of liquid
   - _____ type of yeast food
   - _____ temperature of water in bowl
   - _____ amount of yeast
   - _____ amount of liquid
   - _____ amount of yeast food

   other materials to be used (name or describe the materials or equipment you will use)

   - _____
   - _____
   - _____
   - _____
   - _____
   - _____

Steps to Follow

5. Describe what you are going to do to test your variable.

Observations

6. Make a chart and record your observations.

Interpretations

7. a. Did the variable you chose to test cause the yeast to muliply more quickly or more slowly?

_____

b. How do you know?

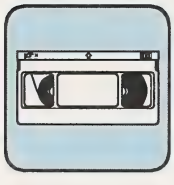
_____

_____

Discuss your answers with your learning facilitator.

Activity 4: Viewing a Videocassette (Optional)

Note:
- The videocassette for this activity is called *Microbeasts and Disease*. Check with your learning facilitator as to its availability.
- If you do not have a videocassette player, are unable to obtain the necessary videocassette, or prefer not to watch the videocassette for this activity, you may omit Activity 4 and move on to the Follow-up Activities.



The program on this videocassette, called *Microbeasts and Disease* was made in England. It shows how some micro-organisms are harmful, while others are helpful, and gives an historical point of view of the relationship between micro-organisms and disease. It uses the word microbeasts to refer to micro-organisms.

Please answer the following questions in full sentences. To do this, you may need to stop the videocassette while answering the questions. The questions are based on the first 10 minutes of the video program. At times the sound track may be hard to hear because of background noise. If you have trouble understanding what is being said, stop the videocassette and rewind it so that you can listen again. After you have answered the questions, stop the videocassette. You will watch the rest of the video program in later sections of this module.

1. How did the bubonic plague get to the village of Een in 1665?

_____

_____

2. How did the people of the village avoid spreading the disease?

_____

_____

3. What was Dr. Jenner's theory on why milkmaids never caught smallpox?

_____

_____

4. Dr. Jenner's research and his treatment of the boy is shown in a humourous way. What was the serious job that Dr. Jenner was trying to do?

_____

_____

5. How did Dr. Jenner test his theory?

_____

_____

6. What was the result of Dr. Jenner's experiment?

_____

_____

7. What was found on the tip of a pin after several magnifications?

_____

_____

8. How do microbeasts (micro-organisms) grow?

_____

_____

9. If you started with one micro-organism that could divide into two micro-organisms every 20 minutes, how many micro-organisms would you have after

   a. one hour? _____

   b. three hours? _____

10. a. After collecting samples from different surfaces and spreading them on agar plates, where are the dishes placed?

   _____

   b. Why?

   _____

11. What makes bread go mouldy?

   _____

   _____

After you have answered these questions, stop the videocassette. You will watch the rest of it in the next section of this module.

Check your answers with your learning facilitator.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

Extra Help

The word *micro-organism* can be broken down to help you understand what it means.

Micro means very small.
Organism means living thing.
Micro-organism means very small living thing.

In fact, micro-organisms are so tiny that you need a microscope to see most of them, and a few are too small to be seen through a regular microscope.

Most micro-organisms are only made of one cell. They are called unicellular. This single cell carries out all the functions necessary to be called living. Some micro-organisms are made of more than one cell. They are called multicellular.

Micro-organisms are found in many different places and come in many different forms. Scientists have classified micro-organisms into five groups. The names of these groups are

- bacteria
- viruses
- algae
- protozoa
- fungi

Because micro-organisms are alive, the rate at which they grow and multiply can be controlled by changing variables in their environment. Some of these variables are

- temperature
- food source
- moisture
- oxygen

Answer the following questions.

1. What does micro-organism mean?

2. Why is it so difficult to see micro-organisms?

3. What do bacteria, viruses, algae, protozoa, and fungi have in common?

4. What evidence suggests that micro-organisms are living?

Check your answers with your learning facilitator.

7 Science Directions

Enrichment

Read pages 272 and 273 of *Science Directions* 7. Find out how Alexander Fleming discovered penicillin, an antibiotic from a mould that has cured millions of people by controlling disease. Answer the following questions.

1. Fleming's discovery of penicillin has been called accidental. What do you think?

2. Micro-organisms are helpful and harmful to humans. Explain what this means.

Check your answers with your learning facilitator.

Conclusion

You may have read ghost stories in which invisible spirits make moaning sounds, cause sudden rushes of cold air, or fling objects about the room. Micro-organisms are a bit like the ghost stories; you cannot see them, but they cause things to happen. Often, you are not even aware that there are micro-organisms around! For example, for thousands of years people observed that uneaten food soon turned rotten. For most people this was just a fact, but others wondered why it happened. Some scientists inferred that unseen living things might be affecting the food. Before the invention of the microscope, however, most micro-organisms were invisible to people. So these scientists could not tell if their inference was correct.

Micro-organisms live in places where you could never survive. As long as they have the right conditions, food, water, darkness, and the correct temperature, they will multiply. All of them don't even need oxygen. Most can go into a dormant stage and wait for the right conditions. Many are made of only one cell, some live in colonies, and some are multicellular. Micro-organisms have many different forms but they are all capable of reproduction and growth, and they all are very small.

Assignment Booklet

ASSIGNMENT

Turn to your Assignment Booklet and do the assignment for Section 2.

Section

3

Making Decisions!

Have you ever seen beetles eating a "cow pie" in a pasture? Did you find it disgusting? It's not at all disgusting if you're a dung beetle! All organisms need a source of energy to be able to grow and multiply.

Micro-organisms don't have mouths. You can't see them eating. But many leave evidence that they are using human food as their energy source. Their methods of getting energy can be helpful or harmful to humans. And some methods don't affect humans at all.

In this section you will find out more about the food and energy relationships of micro-organisms. By the end of this section you should be able to use the knowledge you gained about micro-organisms to make personal decisions about the safe handling of food.

Activity 1: Examining Foods for Micro-organisms

In this activity you are going to examine foods for evidence of micro-organisms. Use as many of the suggested foods as possible. Some may have been treated to prevent micro-organisms from growing on them. You will likely not see evidence of the treatment on the foods.

Materials You Need

- fruit
  - 1/2 orange or lemon
  - a few grapes
  - apple slices
- vegetables
  - thick potato slice
  - fresh green beans
  - zucchini or cucumber slices
- one slice of preservative-free bread
- 250 mL cottage cheese in its container
- 125 mL milk
- 10 mL of soil (not sterilized)
- two small jars with lids
- tape
- paper towels
- plastic wrap
- clear plastic bags
- cookie sheet or pan
- measuring spoon

Steps to Follow

Step 1: Set each kind of fruit on a folded, wet paper towel.

Step 2: Repeat for each vegetable.

Step 3: Repeat for the bread.

Step 4: Place each food in a separate plastic bag.

Step 5: Tie the bags shut very tightly.

Step 6: Cover the cottage cheese in its container with clear plastic wrap. Tape down the edges tightly.

Step 7: a. Divide the milk equally into two jars.

b. Sprinkle 10 mL of soil into one jar.

c. On a label write down the contents of each jar.

Step 8: Place all your foods on a tray, and put it in a warm dark place.

Step 9: Observe the foods each day for six days. **Do not open any of the containers.** Record your observations in the observations chart which follows step 10.

Under no circumstances are you to open the containers for a closer look at the food. There shouldn't be micro-organisms harmful to humans in the food, but there may be. You must treat the food as potentially dangerous. If you are doing this activity at home, tell all family members about the potential danger of opening the containers. If there are very young children at home, keep your foods in a place where they cannot get at them.

Step 10: When you are finished, place everything into a large plastic bag, seal it, and put it into the garbage.

Observations

Describe any changes that have taken place.

Food	Day 1	Day 2	Day 3
orange or lemon			
grapes			
apple slices			
potato slice			
green beans			
zucchini or cucumber slices			
bread			
cottage cheese			
milk			
milk and soil			

Observations (continued)

Food	Day 4	Day 5	Day 6
orange or lemon			
grapes			
apple slices			
potato slice			
green beans			
zucchini or cucumber slices			
bread			
cottage cheese			
milk			
milk and soil			

Interpretations

1. Describe evidence for the growth of micro-organisms on each of the following foods.

   a. orange or lemon

   b. grapes

   c. apple slices

   d. potato slice

   e. green beans

f. zucchini or cucumber slices

g. bread

h. cottage cheese

i. milk

j. milk and soil

2. Why do you think the spoilage on each food looked somewhat different?

3. a. Which had the most micro-organisms, the milk or the milk with soil?

_____

b. What evidence do you have for this?

_____

_____

_____

c. Why do you think it had more micro-organisms than the other sample?

_____

_____

4. a. List any foods that did not show evidence of decay.

_____

_____

b. Give reasons why they did not decay.

_____

_____

_____

5. List four conditions that are needed for micro-organisms to grow.

- _____
- _____
- _____
- _____

Discuss your answers with your learning facilitator.

Activity 2: Making Decisions

Earlier in this module you learned that micro-organisms can cause food to spoil. You also learned that the growth of micro-organisms is affected by the conditions in which they are found.

You will now consider how this knowledge is used in making decisions about the food you eat. In this activity you will be asked to think about what you would do based on the knowledge you have gained to this point.

Read each of the two stories that follow. Imagine you are the person involved. Then answer the questions following each story.

Story A

You and your family drove for an hour to a picnic site. For the next two hours you walked through the forest, watched squirrels, and threw rocks into a pond. When it was time to eat, your father set out the food that had been packed in a cardboard box and had been sitting in the trunk of the car. One of the items was a 250 mL carton of chocolate milk.

1. a. Would you drink the milk?

   _____

   b. Why or why not?

   _____

   _____

   _____

2. If you do not think the milk is safe, how could you have handled it differently so it would be safe?

   _____

   _____

   _____

Story B

You have just purchased oranges or lemons from the store. They were in a refrigerated bin. When you arrived home you had to decide where to store them.

Use the information you gathered in Activity 1 regarding the spoiling of oranges or lemons as your scientific knowledge about the spoiling of oranges or lemons. Then decide where you will store them at home. Will you store them in a bowl on the counter or in the refrigerator?

3. Where should the oranges or lemons be stored?

_____

_____

4. Why did you choose the method of storage you did?

_____

_____

_____

_____

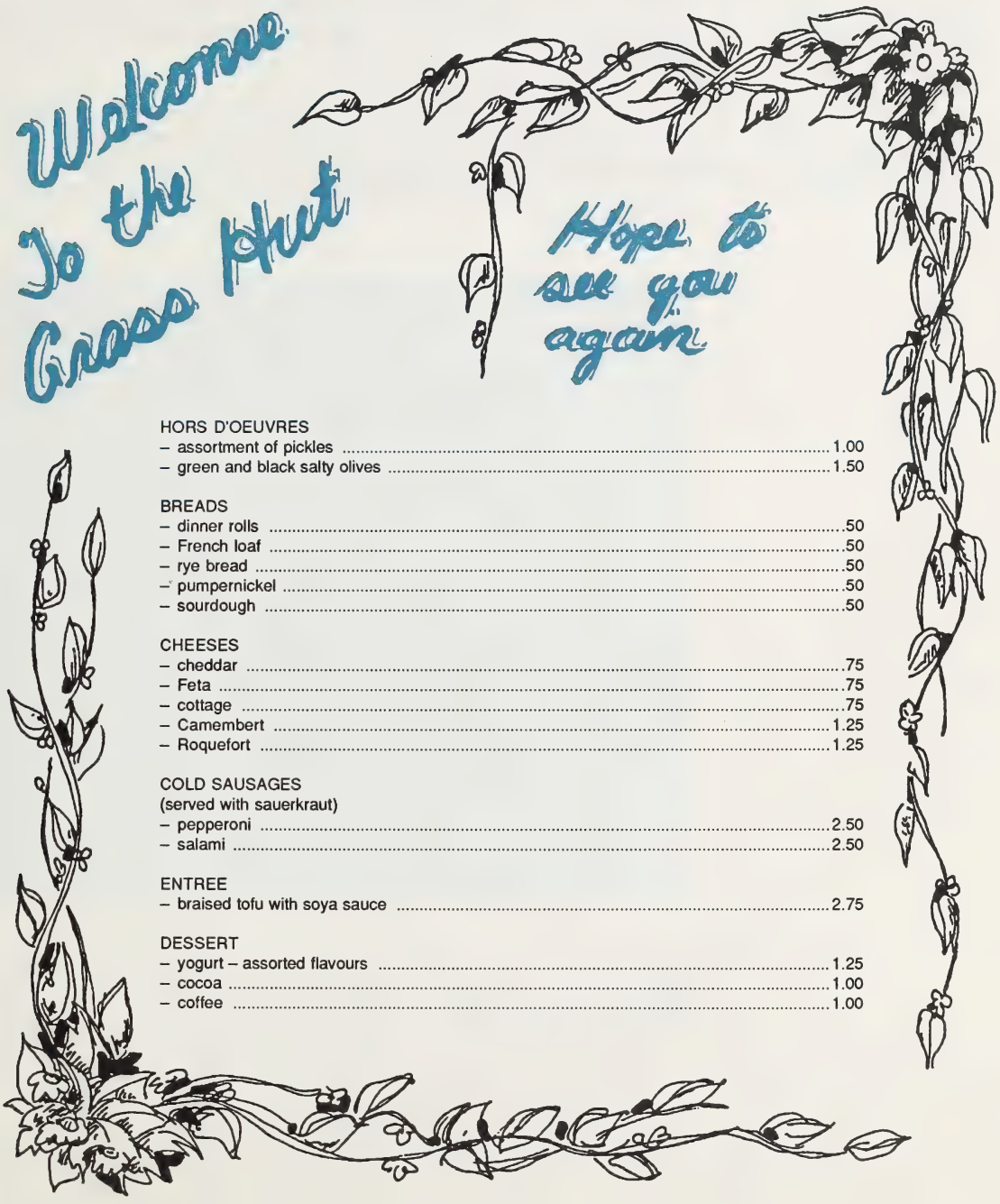
Activity 3: A Meal of Micro-organisms

As an introduction to this activity read Micro-organisms that Produce Food on page 277 of *Science Directions 7*.

Imagine a meal of micro-organisms – tiny creatures of all shapes and colours. Would you eat it? Would it be safe?

It depends. Not all micro-organisms are harmful. In fact, many are used in preparing the food you eat. Imagine a buffet lunch with a menu like the one which follows.

Did you know that micro-organisms are used in the preparation of each of these foods?



HORS D'OEUVRES
– assortment of pickles 1.00
– green and black salty olives 1.50

BREADS
– dinner rolls ..... .50
– French loaf ..... .50
– rye bread ..... .50
– pumpernickel ..... .50
– sourdough ..... .50

CHEESES
– cheddar ..... .75
– Feta ..... .75
– cottage ..... .75
– Camembert 1.25
– Roquefort 1.25

COLD SAUSAGES
(served with sauerkraut)
– pepperoni 2.50
– salami 2.50

ENTREE
– braised tofu with soya sauce 2.75

DESSERT
– yogurt – assorted flavours 1.25
– cocoa 1.00
– coffee 1.00

Ferment: undergoing a gradual chemical change in food caused by micro-organisms, such as yeast or bacteria, giving off bubbles of gas

Processing: changing a material such as food from one form to another, often by cleaning, combining materials, and cooking

You would eat some of the foods on this menu, wouldn't you? Well, you would be eating not only the foods, but also the micro-organisms (or their remains) that made the foods what they are! They have been **fermented**. This means that the food in its original form has been broken down and changed into simpler parts by micro-organisms.

The following chart provides several examples of how micro-organisms have been used in **processing** some of the foods shown in the menu. The chart has three columns – the first column names a food source in its original form, the second describes changes caused by micro-organisms, and the third names the new food product.

Original Food	Process (simplified)	Fermented Food
milk	Bacteria are added to milk; it undergoes several temperature changes and aging before the milk changes to a curd.	cheese
cocoa bean	The outer part of the bean is a soft flesh. Bacteria and fungi ferment it, changing the taste. It is then ground for use.	chocolate
coffee bean	The outer part of the bean is a soft flesh. Bacteria and fungi ferment it, changing the taste. It is then ground for use.	coffee
soya beans wheat	Bacteria ferment a mixture of soya beans, roasted wheat, and steamed wheat bran. The liquid is strained off.	soya sauce
soybean milk	Soybean milk is fermented with mould; water is pressed out of the curd and it's shaped.	tofu
grapes	Yeast changes the sugar in grapes to alcohol.	wine

Note that in each case a particular group of micro-organisms is put to use. In each case micro-organisms that would cause disease are not used; instead ones that cause desirable changes in the food are used.

1. Each of the original foods has been changed in some way by micro-organisms. In each case the original food has had at least three things altered:

   - taste
   - texture (how it feels)
   - appearance

   For each of the following processed foods, list one main difference from the original food.

   a. milk → cheese

   _____

   b. cocoa bean → chocolate

   _____

   c. coffee bean → coffee

   _____

   d. soya bean, wheat → soya sauce

   _____

   e. soybean milk → tofu

   _____

   f. grapes → wine

   _____

2. Choose one of the original foods from the chart, and show how the food is changed by fermentation. Use diagrams, pictures, flow charts, or any means you wish to illustrate the change.

Check your answers with your learning facilitator.

Activity 4: How Is It Made?

In Activities 1 and 3 in this section, you saw or read about evidence of micro-organisms growing in food. The evidence was one or several of the following:

- a change in taste
- a change in appearance
- a change in texture
- a change in smell

In Activity 1 some of the food was spoiled and was no longer good for you to eat. In Activity 3 you read about food that was fermented. This process used micro-organisms to change food into a new form that is good for you to eat.

The changes in the food are sometimes beneficial and sometimes harmful to food. Have you ever wondered how some of the foods that you eat are actually made? You can find information about food from your library, Agriculture Canada, and companies that produce foods.

Another way to find out is to make some food yourself. Yogurt is easy to make. You cannot make yogurt without micro-organisms. Yogurt is a good example of a beneficial effect of micro-organisms.

In this activity you will see evidence of micro-organisms multiplying during the production of yogurt.

Do either Part A or Part B.

Part A involves making yogurt and answering questions 1 to 5.

Part B involves learning about making yogurt by reading a recipe, filling in a chart, and answering question 6.

Part A

Note: You do not need to complete Part A if you wish to do Part B.

Caution

This activity should be done under the supervision of a parent or learning facilitator.

Materials You Need

- 1 L pasteurized milk (whole or 2%)
- 10 g milk powder
- 30 mL plain yogurt or 5 g yogurt culture
- measuring spoon
- saucepan
- thermometer
- four or five very clean jars or other containers with lids
- spoon

Steps to Follow

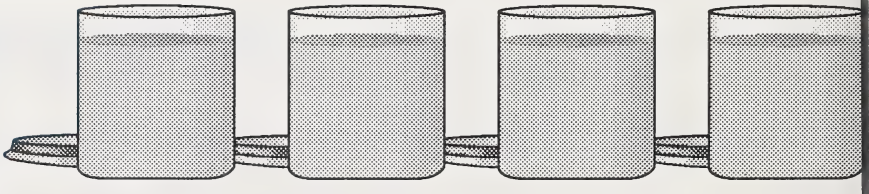
Step 1: Heat the milk and milk powder to 82°C in the saucepan. Stir it occasionally.

Step 2: Keep the mixture at this temperature for 30 minutes. Stir it occasionally.

Step 3: Cool the mixture to 45°C.

Step 4: Add the 5 g of yogurt culture bacteria or 30 mL of plain yogurt. Stir thoroughly.

Step 5: Pour the mixture into the clean, warm jars, filling the jars to within 2.5 cm from the top.



Step 6: Use one of the following three methods to keep the culture warm. The methods are listed in order of preference.

Note: Whichever method you choose, do not jiggle the jars while the milk is fermenting. It may take from 3 to 8 hours before the yogurt is thick. Fermenting it too long will make the yogurt very firm, but this will also give it a strong taste.

- Method A

  Place the jars in a yogurt maker. A yogurt maker is designed to keep the jars at 45°C.

- Method B

  Place the jars in a pan of water at 45°C. The water level should be even with the yogurt in the jars. Cover the pan with towels and set it in a warm place to maintain the 45°C. Two ways to maintain this temperature are listed.
  - Place the jars in the pan of water in the oven at a barely warm setting – about 65°C (this is equivalent to 150°F).
  - Place the jars in the pan of water on the top of the stove, on the flat part between the burners, with the oven set at 105°C to 110 °C (this is equivalent to 220°F to 230°F).

- Method C

  Place the jars in a pan of water at 45°C. The water level should be even with the yogurt in the jars. Cover the pan with towels; then wrap it in a down-filled jacket or sleeping bag. Put it in a cozy or warm place (e.g., on top of the refrigerator).

Step 7: When the yogurt is firm, store it in the refrigerator to cool it.

If you find the yogurt too tart to eat, add some sweet flavourings. The bacteria are still living. The longer the yogurt sits in the refrigerator, the more tart it will taste. By the way, these bacteria are useful in your intestine. They help the bacteria already there with digestion of foods.

Questions to Answer

1. Why do you think it was important to keep the mixture at 45°C?

_____

_____

2. You used milk and bacteria to make yogurt. You added 1 L of milk and 10 g of milk powder. How did you add bacteria?

_____

_____

3. Why do you think the yogurt would taste stronger if you ferment it too long?

_____

_____

4. Why should you store yogurt in a cool place after it has been made?

_____

_____

5. List evidence you observed that there are micro-organisms in the yogurt you made.

_____

_____

_____

Check your answers with your learning facilitator.

Part B

Note: You do not need to complete Part B if you have already done Part A.

Steps to Follow

Step 1: Read the following recipe for making yogurt.

Step 2: Fill in the observations chart and answer the interpretations that follow.

Yogurt Recipe

1. Heat 1 L of pasteurized milk with 10 g of milk powder to 82°C. Keep at this temperature for 30 minutes; then cool it to 45°C.
2. Add 30 mL of plain yogurt or 5 g of a yogurt-forming bacterial culture.
3. Pour the milk into warm jars or containers with lids.
4. Place the jars in a yogurt maker, which will hold the temperature at 45°C. Keep it there for 3 to 8 hours, until the milk has been fermented by the bacteria and the yogurt is firm.
5. Stop the fermentation by placing the jars of yogurt in the refrigerator.

Observations

The bacteria used to make yogurt must meet three conditions before they will multiply. In the following chart, list the conditions. Then describe how those conditions are met when making yogurt. (To get you started, one of the three conditions has been identified for you.)

Conditions	How the Conditions Are Met
• The bacteria must have food for growth.	
•	
•	

Questions to Answer

6. a. Do you think the bacteria in the yogurt have been killed after it has been fully prepared?

_____

_____

b. Give reasons for your answer.

_____

_____

_____

Check your answers with your learning facilitator.

Activity 5: More Uses for Micro-organisms

You might think that you would be better off if there were no micro-organisms. There would be no more rotting food. However, without micro-organisms, no other forms of life could survive for very long.

7 Science Directions

Turn to page 266 of *Science Directions 7* for more information on this topic and on how all living things on Earth can be classified into three groups according to the way they obtain their food. Then read the story under Pass the Food, Please on page 267 of the textbook to discover how the three groups of organisms interact in the environment.

Answer the following questions about the story on page 267 of the textbook.

1. List the **producers**, the **consumers**, and the **decomposers** in the story.

Producer: in biology, an organism that makes (produces) its own food

Consumer: in biology, an organism that obtains its food by eating other organisms

Decomposer: an organism that obtains its food by breaking down wastes and dead materials

Producers	Consumers	Decomposers

2. List two places where you would expect to find many decomposers.

   a. _____

   b. _____

3. If there were no decomposers, what would happen to wastes and dead matter in the soil?

   _____

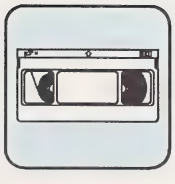
   _____

4. If there were no decomposers, what would happen to the amounts of nutrients in the soil?

5. Continue the story of the apple core, explaining what might happen to the nutrients after they pass from the grass plants.

Check your answers with your learning facilitator.

Activity 6: Viewing a Videocassette (Optional)



If you viewed the videocassette *Microbeasts and Disease* earlier in this module, continue with your viewing and answer the following questions. If you have not been viewing this program, go to the Follow-up Activities.

To answer the following questions, start the video program where you left off in Section 2 (about half-way through) and continue up to the end of the sneeze.

1. What do microbeasts (micro-organisms) in your gut (stomach) help your body to do?

_____

_____

2. Why do cows need micro-organisms?

_____

_____

3. How do dairies use micro-organisms?

_____

_____

4. What micro-organisms are used in making beer?

_____

5. Once the micro-organisms are added to the liquid, where is the liquid left to develop into malt?

_____

_____

6. How long does it take for malt to begin to turn into beer?

_____

7. Micro-organisms make methane. What is it used for?

_____

8. Many micro-organisms are useful while others are harmful. What are some harmful effects of micro-organisms?

_____

_____

9. What did Joseph Lister invent? What was it used for?

_____

_____

10. How did Florence Nightingale cut the death-rate in hospitals from 40 percent to 2 percent?

_____

_____

11. What is one way that micro-organisms can be spread from person to person?

_____

_____

_____

Note: Stop the videocassette after the sneeze. You will view the last part of the video program in the next section.

Check your answers with your learning facilitator.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

Extra Help

All living things, including micro-organisms, have some basic common characteristics. You learned about these in Module 1.

One of these common characteristics is the need for energy. Organisms must find food to get energy from or they must make their own food. All living functions, from food gathering, to growth, to reproduction, require energy.

Photosynthesis: a process in which food is made by using carbon dioxide from the air, nutrients from the soil, and energy from sunlight

Organisms that make their own food are called producers. Producers use energy from the sun to make food from nutrients and carbon dioxide. This process is called **photosynthesis**. Without producers, no other forms of life could exist.

Consumers eat food for energy. Foods containing sugars, fats, and oils provide you (and other consumers) with a source of energy. The food for consumers is producers and other consumers.

Decomposers use dead organisms and waste material for a source of energy. In doing so, decomposers return nutrients to the soil and oceans.

Bacteria, viruses, algae, protozoa, and fungi are different types of micro-organisms. Micro-organisms get their energy to survive from a variety of food sources. Some micro-organisms are producers, some are consumers, and others are decomposers. In many cases micro-organisms use the same food as you do.

1. What do organisms use energy for?

_____

_____

_____

_____

2. Where do organisms get their energy?

_____

_____

_____

_____

3. Classify each of the following micro-organisms by writing *producer*, *consumer*, or *decomposer* in the space provided.

a. _____ Diatoms are a type of algae. Diatoms live in oceans and are responsible for over half of the Earth's photosynthesis.

b. _____ Paramecia are a type of protozoan that feeds on bacteria.

c. _____ Moulds are a type of fungus. Some moulds break down dead leaves and trees and return nutrients to the soil in the forest.

d. _____ Euglena are a type of protozoan. Euglena move like animals but make food like plants.

e. _____ Some types of food poisoning are caused by bacteria as they break down food.

The detection of micro-organisms is not easy because of their small size. But by studying the changes they cause, micro-organisms can be detected and identified. For example, in Section 2 you observed that yeast causes dough to rise. And from your own experience, you can identify that you have a virus when you develop cold or flu symptoms (tiredness, aching body, runny nose, and perhaps a cough).

If it was your job to detect micro-organisms in a food supply, you would look for the following changes:

- a change in taste
- a change in appearance
- a change in texture
- a change in smell

4. For each of the following situations, food has been changed in some way by micro-organisms. What features of the food are altered? (Your answer might include such features as colour, taste, smell, texture, and appearance.)

   a. milk → cheese

   _____

   b. grapes → wine

   _____

   c. apple → apple with bruise

   _____

   d. cocoa beans → chocolate bar

   _____

If the food was changed in such a way as to make it unpleasant or harmful for you to eat, you would consider the food to be spoiled. If the changes don't spoil the food, but just change the taste, you would consider the food to be fermented.

5. For each of the following situations, food has been changed in some way by micro-organisms. Write *spoiled* or *fermented* in each space.

   a. milk → cheese _____

   b. grapes → wine _____

   c. apple → apple with bruise _____

   d. cocoa beans → chocolate bar _____

Check your answers with your learning facilitator.

Enrichment

In this section you have learned how micro-organisms are used to change food from one kind to another. You may wish to consult an encyclopedia or other references to learn more about this and about how cheese is made. This will help you answer the following questions.

1. Little Miss Muffet is famous for eating her curds and whey, while sitting on a tuffet. A tuffet is a low stool. What are curds and whey?

_____

_____

_____

_____

_____

_____

2. One of the steps in making cheese is curdling milk. What is curdling?

3. Most cheddar cheese comes in mild, medium, or sharp form. What does this refer to, and how is it attained?

4. How does Roquefort cheese get its colour and strong taste?

5. Some cheeses are quite soft, like cream cheese and cottage cheese. Others are quite hard, like cheddar cheese and parmesan cheese. What is the difference between hard and soft cheese?

Check your answers with your learning facilitator.

Conclusion

Micro-organisms are too small to be seen in food, but you can infer their presence if you observe changes such as

- colour changes
- shiny, wet-looking spots
- coloured fuzz or threads
- slime
- a different smell

Micro-organisms need a source of food to be able to grow and multiply. If they change the food source in such a way as to make it unpleasant or harmful for you to eat, this food is spoiled. Spoiled food is a harmful effect of micro-organisms. If the changes don't spoil the food, just change the taste, this food is fermented. Fermented food usually will not have other kinds of micro-organisms growing in it. Making different types of food is a helpful effect of micro-organisms.

Your new understanding about micro-organisms should be causing changes in how you feel about them. They are everywhere. They are difficult to get rid of. But you can thank at least some micro-organisms for making it possible for you to have a cheese sandwich, yogurt, and tofu ice cream.

Assignment Booklet

ASSIGNMENT

Turn to your Assignment Booklet and do the assignment for Section 3.

Section

4

Food Technology

Imagine you are living in an age when building a fire is one of the few technologies known. What would you eat? Would it be cooked or raw? Could you keep meat safely in your cave for tomorrow's lunch?

Do you remember the lunches you've eaten at school or at home over the past week? What were they? Did you have sandwiches of peanut butter, cheese slices, luncheon meat, or tinned salmon? What did you have to drink? Did you have milk in a carton, pop in a can or bottle, or a box of juice? Did you have any fruit such as bananas, apples, or oranges? Did you have anything sweet such as a granola bar, cookie, or canned pudding snack? There are foods to eat now that primitive people couldn't have even dreamed about. Even 100 years ago these choices were not possible. And even 25 years ago some of these foods weren't found in Alberta.

Technologies are being developed continuously to preserve and protect human food. In this section you will find out more about these technologies.

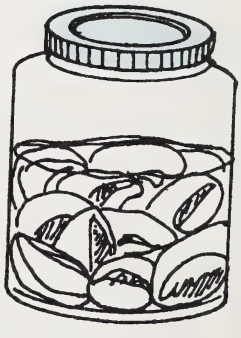
Activity 1: Food Processing

Processing food can mean three different things.

- Food is separated from one or more of its parts (e.g., peeled, shelled, eviscerated).
- The size or shape of food is changed (e.g., cut, ground, kneaded).
- Food is preserved by stopping or slowing down food spoilage caused by micro-organisms (e.g., canned, frozen, fermented).

This chart shows three types of processing. Some foods may require only one type of processing. Some foods may require all three types of processing.

Processing Food

Separating Its Parts	Changing Its Size Or Shape	Preserving
(e.g., removal of peach pits)	(e.g., slicing peaches)	(e.g., jars of preserved peaches) 

Canning: a method of preserving food by sealing it in airtight jars or cans

This activity is about the technology of **canning** foods. Often canning is thought of as food in metal cans bought at the store. However, there is another type of canning that is often done at home. This type of canning uses sealer jars rather than metal cans. This is the kind of canning that Activity 1 is about.

Part of this activity involves actually doing some canning to preserve some sliced apples. This part of the activity is optional and should be done only if you have the equipment and an adult present to supervise you. However, even if you do not do the canning, you are to read through the activity and answer all questions.

The technology of food canning is based on two main steps. For the canning of apples these two steps are

- Any micro-organisms in the apples and in the containers used must be killed.

  This is done by placing the apples and containers in boiling water for a specified time to kill the micro-organisms.

- Micro-organisms are kept from entering the containers once the apples have been put into them.

  To prevent micro-organisms from entering the containers (sealer jars), a lid is placed on each full jar, but not so tightly as to seal it. When the apples are heated again, air in the jars expands and leaves out of the top. When the jars are cooled, the metal lids get pressed down from the outside as the air inside also cools. The lids have a coating of rubber on them, and when they are pressed down, a seal is formed. No air (with oxygen or micro-organisms) can be drawn in. A partial vacuum has been formed.

Preserving Apples

Caution

This part of the activity before Questions to Answer, is to be done by only those students who have the materials to use and a learning facilitator or another adult who will assist the student. This person should work with the student to ensure that all steps are done safely.

- five or six apples
- knife
- cutting board
- spoon
- clean cloth
- tongs
- mason jar with lid
- a saucepan large enough for the jar to fit inside
- a saucepan of about 2 L capacity
- stove

Steps to Follow (Preparing the Jar)

Step 1: Put the jar into the saucepan and add enough water to cover it completely.

Step 2: Bring the water to a boil. When it starts boiling, time it for 5 minutes.

Step 3: Drop in the lid and boil for 5 more minutes.

Step 4: Keep the water simmering until you are ready to use the jar.

Step 5: Ask the learning facilitator to use the tongs to lift out the jar and lid. You will still need the boiling water.

Steps to Follow (Preparing the Apples)

Step 1: Wash the apples; then cut them into quarters.

Step 2: Cut the core out, and peel each section.

Step 3: Slice the apples about 0.5 cm (or less) thick.

Step 4: Put them in a saucepan with about 100 mL of water, cover the pan, and cook them slowly for 20 to 30 minutes or until they are soft.

Sterilized: an object or substance that no longer contains any micro-organisms

Step 5: Spoon them into the **sterilized** jar to within 1 cm from the top. If you get apples on the top of the rim, wipe them off with a clean cloth.

Step 6: Put on the sterilized lid, using the clean tongs.

Step 7: Screw on the ring tightly; then unscrew it 1/4 turn.

Step 8: Place the jar of apples into the saucepan of boiling water. Make sure the water is higher than the jar by 2 cm.

Step 9: When the water starts boiling, time the process for 10 minutes.

Step 10: Ask the learning facilitator to lift the jar out for you. Let it sit undisturbed on the counter until you hear a "thunk" sound. The metal top has been sucked in, and the jar is now sealed. The apples will be safe to eat for years.

Questions to Answer

Note: All students are to answer these questions. Those students who were unable to actually do the canning to preserve some sliced apples are still required to read the entire activity to answer the following questions.

1. One step in food processing involves separating the parts of the food to be preserved from parts to be discarded. In this activity what parts of the apple were separated from the parts that were to be preserved?

_____

_____

2. Another step in food processing involves changing the size or shape of the food. What changes were made in the size or shape of the material to be preserved?

_____

3. A third step in food processing is the preservation of the food. In this step all micro-organisms must be killed or prevented from growing.

   a. How were they killed on the apples?

   _____

   b. How were they killed on the jar and lid?

   _____

4. When preparing the apples in step 5, you were to wipe the top of the jar rim if you got apples on it. Why should you do this?

   _____

   _____

5. When preparing the apples in step 7, the jar ring was to be unscrewed 1/4 turn after being tightened. Why?

   _____

   _____

6. Scientific knowledge can often explain why a technology works. Summarize, in the following chart, how canning apples applies scientific knowledge of micro-organisms.

Science Knowledge	Canning Technology
Certain types of micro-organisms are killed when they are boiled for a period of time.	
Micro-organisms that spoil apples need oxygen to live.	

Check your answers with your learning facilitator.

Activity 2: Food Preserving Technologies

Canadians used to live in a society that was primarily agricultural. Food was used close to where it was grown. Craft methods of food preservation, such as drying and smoking, were used. You have already seen how science can explain why these craft methods are successful in preserving foods.

Gradually society has become industrialized. Food is grown in particular areas and is often transported long distances across the country. Much of the food you eat comes from other countries. Often the food you eat must be stored for a long time before it is eaten. Because of these changes, society needs convenient ways of preserving food; new technologies have been developed.

Scientific knowledge helps to develop new technologies by

- explaining why earlier methods worked, so that these methods can be developed for efficient production of large quantities of preserved food
- providing new understanding about micro-organisms, which has led to new ways to preserve food

Here are some examples.

Cooling and Freezing

You have already learned in an earlier section how food that is kept cool in refrigerators or frozen in freezers takes longer to spoil than food that is warm. Review page 282 of *Science Directions 7* to find out how freezing came to be used for long distance food shipment and for storage of food.

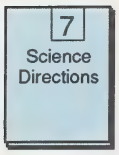
7 Science Directions

Canning

In the early 1800s a French chef, Nicolas Appert, developed the first effective method for home canning. He packed food into jars, sealed the jars and then put them into boiling water. The heat killed the micro-organisms in the food, and the air-tight containers prevented the food from being infected through exposure to air. This is the same technology that you used to process the apples.

In 1858 John Mason, an American glass blower, invented a jar with a screw-on lid. This allowed companies to preserve food on a large scale. The big problem with this method is that glass can be broken during handling and transportation. Another problem is that the high temperatures used to kill the micro-organisms may destroy some of the vitamins in the food.

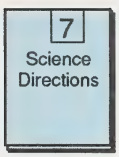
About the same time that jars were first used, people were experimenting with using metal to make food containers. In 1810 Peter Durand, an English merchant, obtained a patent for preserving food in the metal cans. However, in the early days there were problems with cans. Gradually, improvements in technology solved these problems.



Read page 284 of *Science Directions 7* to find out what the problems with the early cans were. Also examine the diagram showing how modern cans are constructed to overcome the problems mentioned.

Almost every type of fruit, vegetable, meat, and fish can now be canned safely. But all cans can dent if dropped, and air may enter through holes too tiny to be seen. (Remember how small micro-organisms are.)

Chemical Additives



In the textbook reading assigned under canning, another food preserving technology was described. If you have not yet read the last two paragraphs at the bottom of page 284 and ending on top of page 285 of *Science Directions 7*, then read these paragraphs now. These paragraphs describe how **chemical additives**, also known as artificial additivies, are used to prevent the growth of micro-organisms in food.

Chemical additive: a substance made by people that is added to food to make it keep longer or look better; also referred to as an artificial additive

Freeze-Drying

Freeze-drying: a method of drying frozen food under a high vacuum in order to preserve it

Freeze-drying is a modern method of removing water from food. The food is frozen quickly so the water in it turns to ice crystals. The ice is then removed by putting the food in a vacuum. This lightweight food is expensive to produce, but is especially useful for campers, soldiers, and astronauts.

Irradiation

Irradiation: a food preserving method which uses radiation to kill micro-organisms in the food

Food is irradiated by exposing it to gamma rays. This kills micro-organisms in the food. It does not make the food radioactive. If the food is then sealed in a container, it can be stored for a long time without refrigeration. More studies are needed to determine whether **irradiation** reduces the nutritional value of food or has any long-term effects on human health.

Food irradiation is an example of technology being ahead of scientific knowledge. Irradiating food works – it keeps food from spoiling. But science cannot yet fully inform you of the long-term effects of eating irradiated food.

Few technologies are perfect. They have both advantages and disadvantages. People must make decisions, based on what they know about the technologies. Should you use preserved food or not?

1. Why is food preservation by industry becoming a larger part of everyone's life?

_____

_____

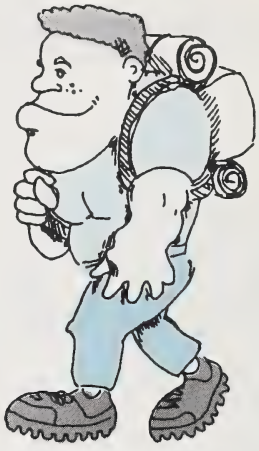
_____

2. Fill in the following chart by briefly describing one advantage and one disadvantage for each method of preserving food.

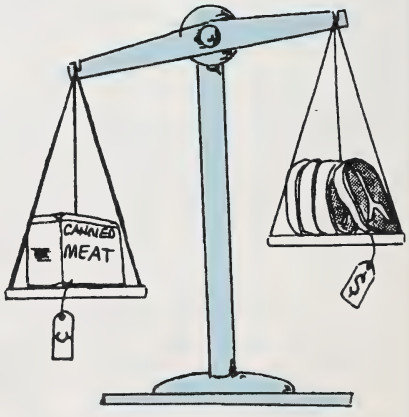
Food Preservation Method	Advantage	Disadvantage
Cooling		
Freezing		
Canning (Using Mason Jars)		
Canning (Using Metal Cans)		
Artificial Additives		
Freeze Drying		
Irradiation		

Activity 3: Other Points of View

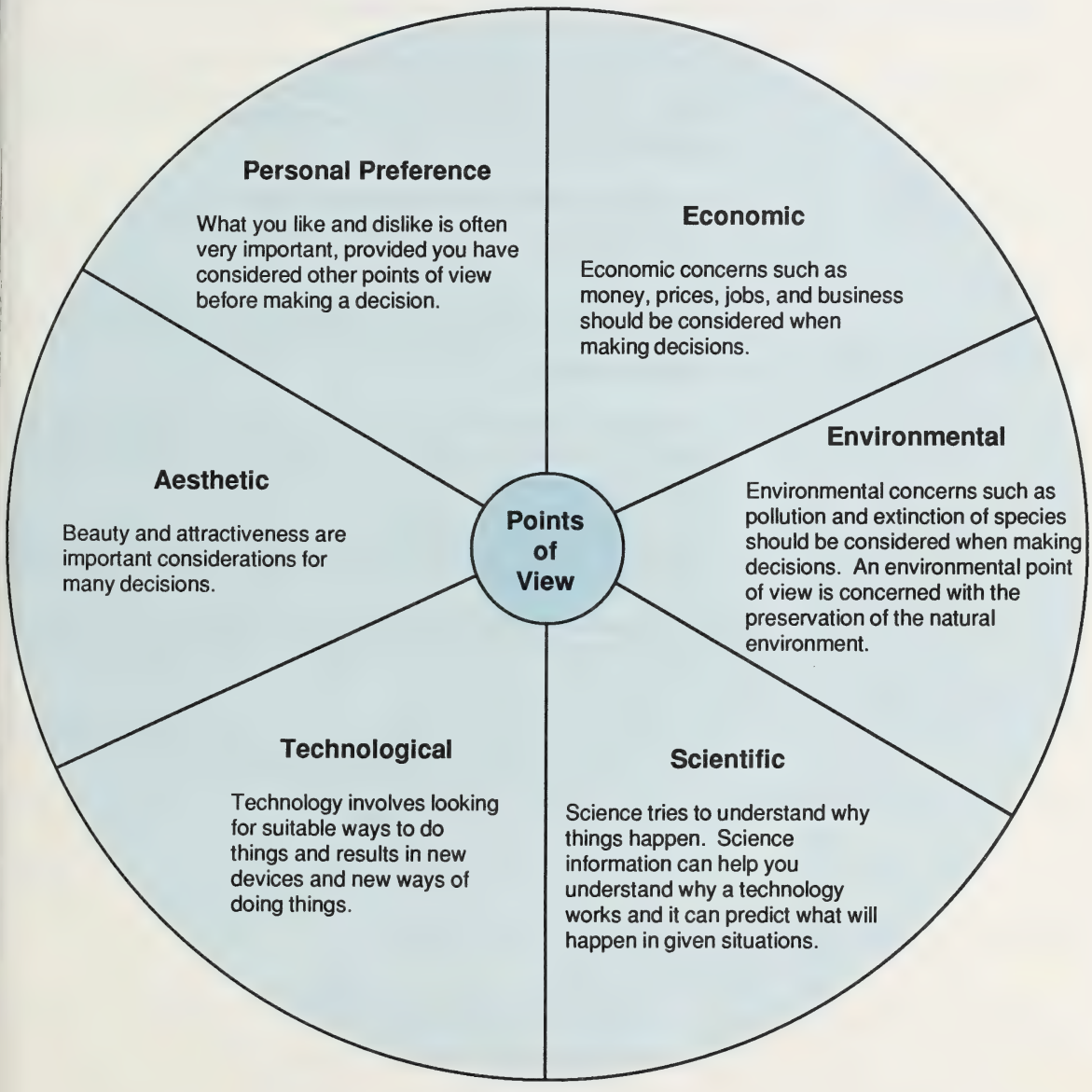
Imagine that you are going on a backpacking trip that will last five days. You will have to carry all your food and other supplies. This means that weight is an important consideration. Also, you want to take meat. You know that raw meat will spoil, so you must decide what type of preserved meat to take.



Consider the alternatives of freeze-dried meat and canned meat. From your knowledge of micro-organisms, both will be safe to eat. But having science knowledge alone will not help you make this decision. What is important to consider is that meat in cans is very heavy compared to packages of freeze-dried meat. Just as important is knowing that freeze-dried meat is very expensive compared to canned meat. For this decision, weight and cost must be considered.



In making a decision you should consider several points of view. Then you must determine which points of view are most important at the time you are making the decision. Here are six points of view with brief descriptions.


Points of View
Personal Preference
What you like and dislike is often very important, provided you have considered other points of view before making a decision.
Economic
Economic concerns such as money, prices, jobs, and business should be considered when making decisions.
Environmental
Environmental concerns such as pollution and extinction of species should be considered when making decisions. An environmental point of view is concerned with the preservation of the natural environment.
Scientific
Science tries to understand why things happen. Science information can help you understand why a technology works and it can predict what will happen in given situations.
Technological
Technology involves looking for suitable ways to do things and results in new devices and new ways of doing things.
Aesthetic
Beauty and attractiveness are important considerations for many decisions.

Now, reconsider the backpacking example. Should you take canned meat or freeze-dried meat? Which of the six points of view are important to your decision? How will they affect your decision?

- Economics will be an important point of view for you because the cost of freeze-dried food might be too expensive for you.
- Science can help you evaluate the effectiveness of the two alternatives. Your scientific knowledge will help you understand that both alternatives adequately deal with micro-organisms so that the meat will be safe to eat for either choice.
- Technology can often inform you of other choices. Perhaps the best decision for your trip is meat preserved in some way other than canned or freeze-dried.
- Personal preference could be very important. Have you compared the taste of freeze-dried meat to canned meat? How much weight can you carry on a backpacking trip?
- Environmental concerns may also be important. How will you prepare the food for eating? Will you need very much fuel? How will you dispose of the packaging materials?
- Aesthetic concerns may be important to you if you like your food to look a certain way or if you have a preference for food in a natural-looking form.

Of course, no one has only one point of view. But thinking about the different points of view will give you a better understanding of why making some decisions is so difficult.

1. Decide which type of meat you would take on the backpacking trip, Explain why you made your decision by referring to points of view.

   a. Which type of meat would you take?

   _____

   b. Why?

   _____

   _____

   _____

   _____

2. Read the information about each of the following food preservation methods. One advantage and one disadvantage has been stated for each method. Identify which of the six points of view each statement represents; then write it in the space provided. An example has been done for you.

   a. Drying: Moisture is removed from the food so that micro-organisms cannot multiply (as in the drying of apples).

      Advantage: This is an inexpensive process that can be done at home.

      Point of View Represented: *Economic*

      Disadvantage: Drying takes a long time to do and it requires great effort.

      Point of View Represented: *Personal Preference*

   b. Ultra High Temperature: Food is heated to a temperature high enough to kill all micro-organisms; then it is stored in air-tight containers.

      Advantage: Once micro-organisms have been killed, they cannot multiply.

      Point of View Represented: _____

      Disadvantage: This process changes the taste of food.

      Point of View Represented: _____

   c. Canning (Mason Jars): This is the process you used to process apples in Activity 1.

      Advantage: The glass jars can be used again once the contents have been eaten.

      Point of View Represented: _____

      Disadvantage: Tests have shown that the high temperatures used destroy some vitamins and minerals.

      Point of View Represented: _____

d. Irradiation: This is one of the newer food processing technologies in which food is sterilized by deadly gamma rays. The food is not radioactive once removed from the radiation.

Advantage: Irradiated food can be shipped long distances without refrigeration.

Point of View Represented: _____

Disadvantage: The long-term effects on human health are not known.

Point of View Represented: _____

Check your answers with your learning facilitator.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

Extra Help

So far in this module, you have learned what micro-organisms are, where they can be found, how they grow, and how they get energy.

But micro-organisms can be dangerous to your health, so you must take care to prevent them from getting into your food, expecially when it is being stored. When food is to be kept, you must prepare food for storage, keeping in mind the conditions that make it easy for micro-organisms to grow and multiply:

- a source of energy (often your food)
- warm temperatures
- moisture
- darkness

Preparing food to prevent the growth of micro-organisms is called preserving food. Many different methods have been developed. Here is a list of some that have been discussed in the module.

- canning, using jars
- canning, using metal cans
- artificial additives
- freeze-drying
- irradiation
- cooling
- freezing
- salting
- drying

1. List two methods that remove moisture to preserve food.

   - _____
   - _____

2. List two methods that lower temperatures to preserve food.

   - _____
   - _____

3. List two methods that kill micro-organisms and prevent them from entering the food.

   - _____
   - _____

Because there are many different methods for preserving food, you have a choice of which method you will use or which type of food to buy. Of course, choices require making decisions. Decisions are influenced by your point of view. For your review, here are six points of view that you will often want to consider:

- Economic – An economical point of view is concerned with money and the cost of things.
- Environmental – An environmental point of view is concerned with pollution and danger to the natural environment.
- Scientific – A scientific point of view tries to explain why things work and helps predict what will happen.
- Technological – Technology tries to develop new ways of doing things.

- Aesthetic – An aesthetic point of view is concerned with how pleasing or attractive something is.

- Personal Preference – This point of view is concerned with your own likes and dislikes about something.

The following example shows how different points of view influence decision making.

Kelvin is trying to decide whether to freeze or dry some peaches for storage so they can be safely eaten at a later date.

If Kelvin considers an economic point of view, he knows that he may have to buy a special dryer to dry the peaches. But, he already has a freezer in the house. Considering only this point of view, Kelvin would likely choose freezing as the best alternative for preserving the peaches.

If Kelvin considers an environmental point of view, he will realize that drying the peaches will have no effect on the environment. But, a freezer often contains CFC's (chlorofluorocarbons) as a cooling agent. Some scientists claim that when CFC's are released into the atmosphere, they are damaging the Earth's ozone layer. This point of view may make drying look like the best alternative.

An aesthetic point of view makes Kelvin think about the taste and appearance of peaches. Dried fruits don't look and taste as good as fresh fruits. Once frozen peaches have thawed, they will appear and taste very much like fresh peaches. This point of view favours freezing the peaches.

Considering several points of view will help you make informed decisions.

4. "Canned meat is much cheaper than freeze-dried meat." Which point of view is this statement considering?

_____

5. "When in the mountains, some people will leave cans laying around because they take up room in their packs. But the plastic bags from freeze-dried foods can be folded and carried away." Which point of view is this statement considering?

_____

6. "Canned meats look and taste like fresh meat, but freeze-dried meats look bland and taste quite dry." Which point of view is being considered in this statement?

_____

7. "Cans often become dented, letting in air and micro-organisms that will spoil the food. Freeze-dried foods contain no moisture, and so leaving them open to the air is fairly safe." Which point of view is being considered here?

_____

8. "Canned meats contain quite a bit of water, making them heavy to carry. Freeze-dried meats are very light." Which point of view is being considered in this statement?

_____

9. a. If you had to choose between canned meat and freeze-dried meat for a backpacking trip, which would you choose?

_____

b. Why?

_____

_____

_____

_____

Check your answers with your learning facilitator.

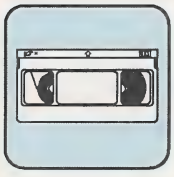
Enrichment

Do either Part A or Part B, or do both Part A and Part B.

Part A involves viewing the last part of the videocassette *Microbeasts and Disease* and answering some questions.

Part B involves writing food safety regulations for street hot dog vendors.

Part A



If you viewed the videocassette *Microbeasts and Disease* earlier in this module, continue with your viewing and answer the following questions. If you have not been viewing this program, go to Part B.

To answer the following questions, start the video program where you left off in Section 3 (from after the sneeze) and continue to the end of the program.

1. What was the first suspect in the sickness of the nine students?

   _____

   _____

2. What does the *stomacher* do?

   _____

   _____

3. a. Of all the bacteria colonies that were grown, were any of them dangerous?

      _____

   b. What does this prove?

      _____

      _____

4. As more people become ill, what was the next step for the environmental health officer?

_____

_____

5. a. What was the second suspect in the spreading illness?

_____

b. What was the result of the agar growth?

_____

6. a. What was the third suspect in the spreading illness?

_____

b. What were the results?

_____

_____

7. What would you do to stop the spread of the illness?

_____

_____

_____

_____

Check your answers with your learning facilitator.

Part B

A group of outdoor hot dog vendors have set up their pushcarts in a nearby town to sell hot dogs on the many busy street corners. The town has no regulations for the cleanliness and safety of the food being sold. Being a concerned citizen and a scientist working for the government, you decide to write some regulations that would ensure that the hot dogs sold from pushcarts on street corners would be safe to eat.

Regulations can govern things such as the type of food served, temperatures that food should be cooked at, how the food is stored, and how extras and garbage are handled. Remember to consider several points of view.

Write six regulations that you think should apply to hot dog vendors. Give reasons for why you chose each regulation.

1. Regulation:

_____

_____

_____

Reason:

_____

_____

_____

2. Regulation:

_____

_____

_____

Reason:

_____

_____

_____

3. Regulation:

_____

_____

_____

Reason:

_____

_____

_____

4. Regulation:

_____

_____

_____

Reason:

_____

_____

_____

5. Regulation:

_____

_____

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Reason:

_____

_____

_____

6. Regulation:

_____

_____

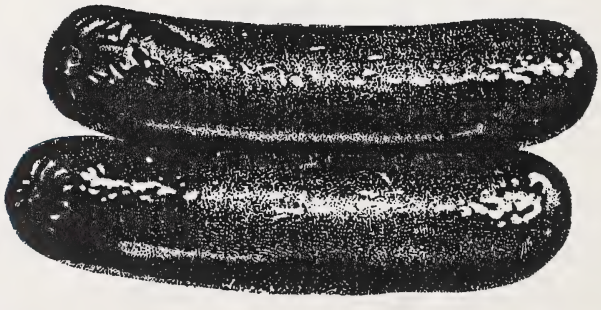
_____

Reason:

_____

_____

_____



Discuss your answers with your learning facilitator.

Conclusion

You will probably have a greater awareness now about the many kinds of processed foods available to you. Technology has developed methods of keeping these foods safe from micro-organisms, based on scientific knowledge about them.

There are often alternative methods of preserving the same food. Your choice of alternative should be based on an understanding of the different points of view that can be used when making decisions.

Assignment Booklet

ASSIGNMENT

Turn to your Assignment Booklet and do the assignment for Section 4.

Section

5

Safety Standards

Every year, thousands of Canadians complain to the government about food products they believe are harmful in some way. You have made some decisions about your own food during this module. How is making decisions about food for a whole country similar to the way you make personal decisions? And how is it different?

The government tries to ensure a safe food supply by making regulations based on information from science and from interest groups with other points of view. This section will help you understand the steps involved in making a regulation to control safety standards for the food you eat.

Activity 1: The Role of Government

Many years ago, there were no rules or regulations about safety standards for food or drink. However, with increasing knowledge of micro-organisms, governments have become involved with the food industry to make regulations that prevent unnecessary illness and death.

Federal: central government of a country; the Government of Canada, located in Ottawa

Provincial: belonging to a particular province rather than the whole country

Municipal: dealing with local areas such as towns, cities, and municipalities

In Canada, there are three major levels of government. The **federal** government looks at the whole of Canada. The **provincial** government has responsibilities here in Alberta. The **municipal** government looks after the city, town, or municipality in which you live. You may have studied these in your social studies course.

Level of Government	Federal	Provincial	Municipal
Some Areas of Responsibility	• trade and commerce • fisheries • agricultural chemicals • patents	• health • hospitals • licensing of businesses • agricultural practices	• local health units

Some of the areas of responsibility overlap. The regulation of food supplies is an example of an area that involves all three levels of government.

As a general rule, the federal government (through its agricultural and fisheries departments) deals with food production. The federal government makes regulations (rules) and ensures that they are followed for

- food that enters Canada from other countries
- food processing
- storage of food
- food additives

The provincial government regulates food handling and the food service industry, which includes restaurants. Since the provincial government is also responsible for health, the Alberta government gives some responsibilities relating to food and health to municipal governments. The municipal governments handle these through the public health offices.

1. a. How many levels of government have a role in making decisions in Canada?

_____

b. Name each level of government.

_____

_____

_____

2. Decide which level of government is responsible for each of the following problems. The first one has been done for you as an example.

a. *federal* Some fish caught near Vancouver Island seem to be contaminated and may cause illness if eaten.

b. _____ A family needs a licence to open a new restaurant in a small town.

c. _____ A small community is upset because several of the inhabitants are very ill and must drive 100 km to the nearest hospital.

d. _____ There is controversy about the use of a chemical that makes chickens grow faster and bigger.

e. _____ Parents want their children tested to find out why so many of them have upset stomachs.

f. _____ A small company is trying to obtain permission to use a food processing method to make yogurt similar to one that a larger company is using.

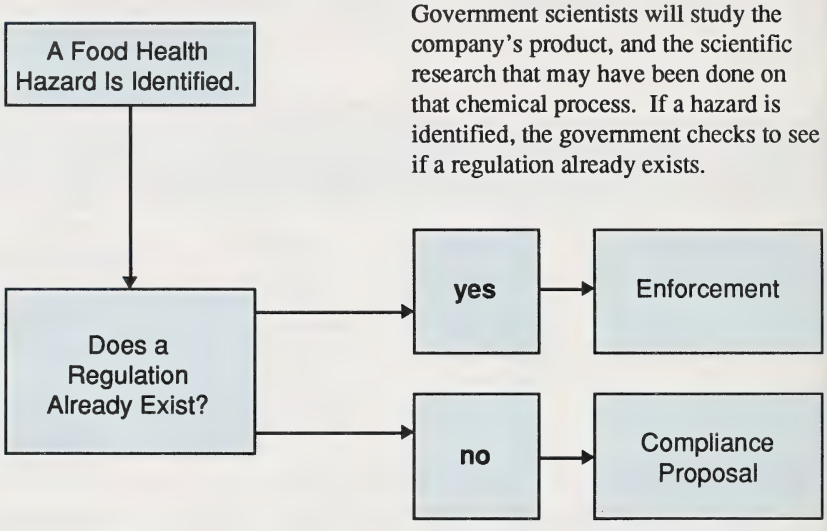
g. _____ A store is trying to import a new brand of cheese and wants to have it approved for sale in Canada.

Check your answers with your learning facilitator.

Activity 2: How Science Helps

Today, scientists working for the government try to prevent problems with foods before they cause illness and death. Scientific testing is used in the federal laboratories to investigate potential problems.

Suppose a food company wants to sell food that has been preserved with a new chemical process. The company must get the federal government's approval. Government scientists will study the company's product, and the scientific research that may have been done on that chemical process. If a hazard is identified, the government checks to see if a regulation already exists.

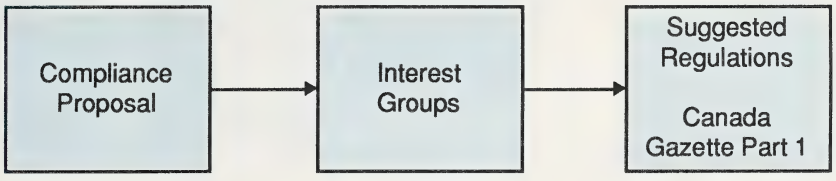


As you can see from the flow chart, if there already is a regulation to control the hazard, the government makes sure that people are following the regulation. They will enforce the regulation.

If there is no regulation in place to control the health hazard that has been identified, then a plan is drawn up outlining ways in which the potential hazard could be controlled so that the food product would be safe. This is called a compliance proposal.

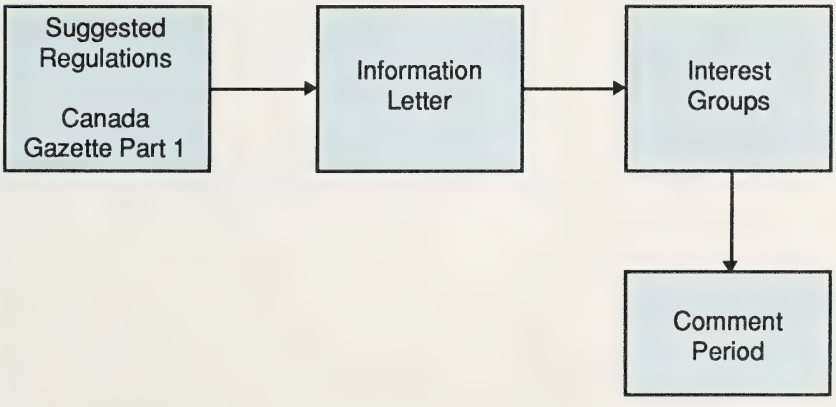
There are many steps that need to be completed before the proposed regulations in the compliance proposal become law. The compliance proposal starts a process that takes about two years to complete. As these steps are discussed on the following pages, you will see how science knowledge is important in making regulations which properly control health hazards relating to food.

Once a compliance proposal is drawn up, a copy of it is sent to interest groups representing different points of view. Examples of these groups are manufacturers, consumers' associations, and health professionals (such as medical doctors and science researchers). The interest groups are asked to make suggestions about how the proposed regulations could be improved. They may suggest banning a particular process, setting safe limits for certain chemicals, or recommending strict processing guidelines.

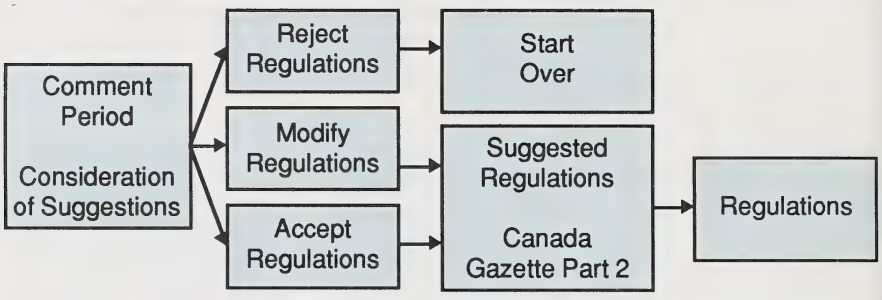


The alternatives and suggestions of the interest groups are evaluated and appropriate parts are incorporated as part of the proposed regulations. Then the suggested regulations are published in Canada Gazette Part 1 (which is part of Hansard, the official publication of the federal government).

An information letter is sent to each interest group explaining the suggested regulations. An additional comment period is allowed for comments so that each interest group can consider from their point of view how the regulations will control the hazard. Politicians can comment at this time, but they usually do not debate the regulations in parliament.



Following the comment period, a decision is made about the suggested regulations. They may be unchanged from the original, modified (changed slightly), or rejected.



If the suggested regulations are accepted or only changed slightly, they are considered by a committee of parliament and passed as law by the Privy Council. At this point, the regulations become law.

When answering the following questions, think about how science knowledge helps in making decisions about food safety regulations.

1. Why does the government make laws about safety standards for food?

2. Why does it take up to two years for the government to pass a law once a concern about safety of food has been identified?

3. What is a compliance proposal?

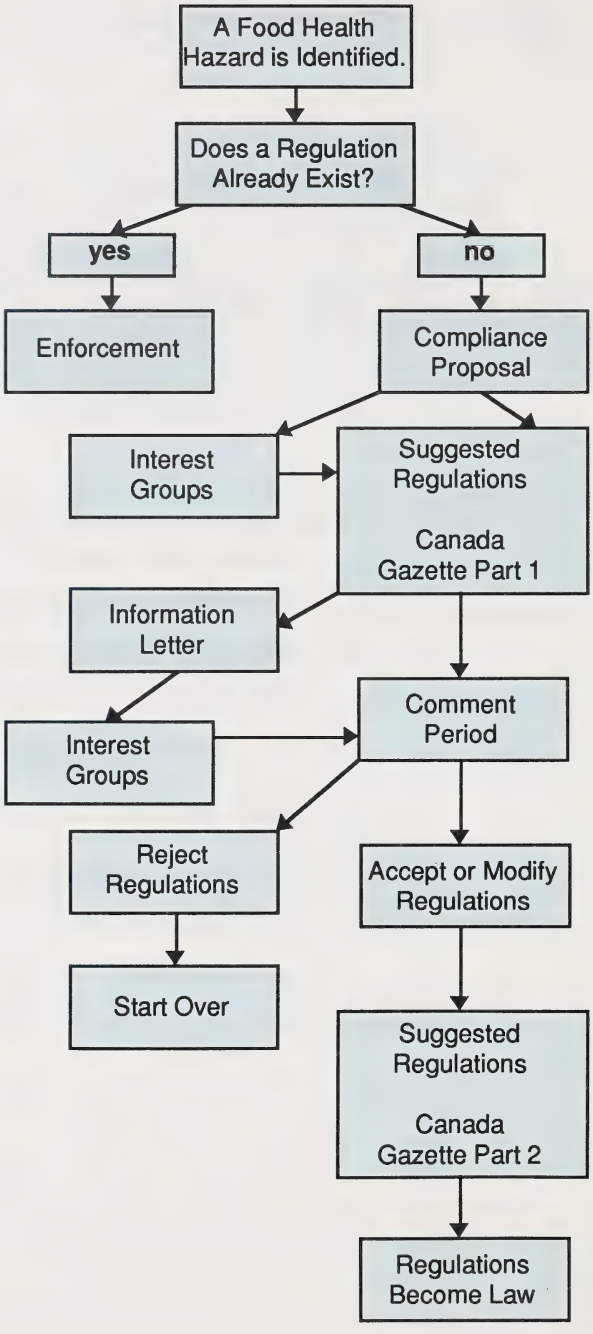
4. What is an interest group?

5. The entire flow chart has been put together for you on the following page.

   a. Identify the places where scientific information and scientists can help the government in setting good safety standards.

   b. Draw circles on the flow chart to show the places you have identified.

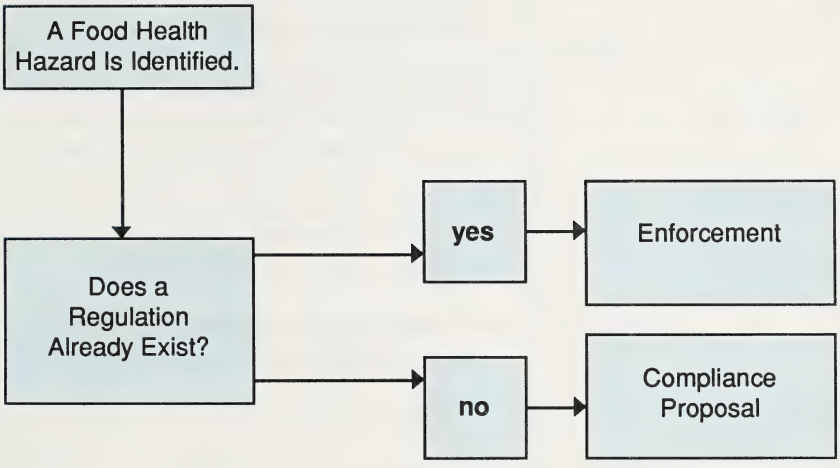
   c. Explain how science can help at each place you circled.



Check your answers with your learning facilitator.

Activity 3: Enforcing Regulations

Remember how the whole process starts. Once a hazard has been identified, the government checks to see if a regulation exists. If there already is a regulation, the government must be sure there is enforcement of the regulation. As you read about how enforcement works, look for places that science information and methods can help.



A food-related health hazard can be identified in two ways.

- Scientific testing in federal laboratories tries to identify hazards before they cause a problem.
- Complaints about food can be made by anyone to the government's Health Protection Branch of the Department of Health and Welfare.

The Health Protection Branch deals with health hazards in five areas: marketed foods, drugs, cosmetics, medical devices, and radiation emitting devices. The only area that this module will deal with is foods. This includes all phases of processing from raw ingredients, to the finished product, to methods of storage.

Inspectors of the Health Protection Branch of the federal government work out of regional and district offices across Canada. Each region has a team of inspectors and a laboratory staff. Alberta food inspectors work out of offices in Calgary and Edmonton. Food and drug inspectors must be university graduates with backgrounds in chemistry, food science, microbiology, or pharmacy. Inspectors receive on-the-job training to keep up-to-date and to help them understand how food technologies work.

Food inspectors try to prevent health hazards in foods by

- offering educational guidance to manufacturers
- inspecting facilities where food is processed, packaged, and stored
- investigating complaints

Food inspectors send samples to federal labs for testing. The tests indicate if cleaning procedures are properly controlling the growth of micro-organisms, and if food has unsafe levels of micro-organisms.

If you have a concern about food you have purchased, you can call the Health Protection Branch. When you call a Health Protection Branch office, an inspector will ask you several questions and fill out a complaint form.

Read each of the questions which follow, and then ask yourself how the answer would help an inspector investigate your complaint. Explain why you think each of the following questions is important.

1. Question: Where was the product bought?
   How will the answer help the investigation?

   _____

   _____

   _____

2. Question: When did you purchase the product?
   How will the answer help the investigation?

   _____

   _____

   _____

3. Question: Were any people made ill? How many people? How old were they? How will the answers help the investigation?

   _____

   _____

   _____

4. Question: What was eaten at the last three meals before the illness?
   How will the answer help the investigation?

   _____

   _____

   _____

5. Question: Has a sample of the suspected food been kept?
   How will the answer help the investigation?

   _____

   _____

   _____

6. Question: Have the original package and contents been saved?
   How will the answer help the investigation?

   _____

   _____

   _____

7. Question: Were the products bought in quantity, and have all been opened?
   How will the answer help the investigation?

   _____

   _____

   _____

Check your answers with your learning facilitator.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the enrichment.

Extra Help

For a review as to how governments became involved in regulating food safety standards, read page 289 of *Science Directions 7*. Then use the words from the word list to complete the crossword puzzle.

Look at the following word list. If you do not know what a word means, look back through this section to find out how the word is used.

Word List

chemistry
federal
gazette
growth
hazards
illness
inspectors
laboratories
law
micro-organisms
municipal
provincial
regulations
safety
toxic
view

Crossword Puzzle

Test your knowledge of how the government sets safety standards by completing the crossword puzzle which follows. Use the words from the word list to complete the crossword puzzle.

Across Clues

2. the cause of food poisoning

7. Scientists help the government identify _____, make new regulations, and investigate complaints.

9. what food poisoning causes

10. A compliance proposal gives the opportunity for looking at different points of _____.

11. Scientists work in federal _____ to investigate problems with food.

14. The level of government that looks after food processing, storage of food, and food additives.

15. people working for the Health Protection Branch of the government, who look into complaints about food handling

Down Clues

1. what regulations become after being published in the Canada Gazette Part II

2. the level of government that looks after local health units

3. The rules made by government to help ensure a safe food supply.

4. To become a food inspector you must study _____, food science, microbiology, or pharmacy.

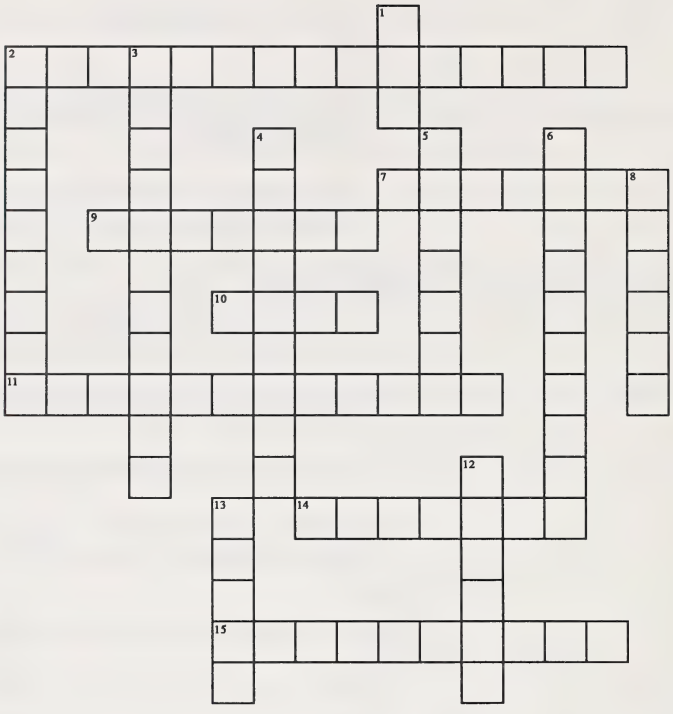
5. Once alternatives are evaluated, suggested regulations are published in the Canada _____ Part I.

6. the level of government that looks after food handling in restaurants

8. To guarantee _____ of food supplies, standards for food processing must be established.

12. Scientists do tests to find out if cleaning procedures are effective in controlling the _____ of micro-organisms.

13. a word meaning poisonous



Check your answers with your learning facilitator.

Enrichment

Read the information under Types of Food Poisoning on pages 274 to 276 of *Science Directions 7*. Answer the following questions.

1. Look at the photograph of the canning situation on the middle left side on page 275 of the textbook.

   a. What is the greatest risk of food poisoning in the situation shown in the photograph?

   _____

   _____

7 Science Directions

b. How can it be avoided?

_____

_____

_____

2. Look at the illustration on the bottom right corner on page 275 of the textbook.

a. What type of food poisoning might result from this situation?

_____

_____

b. How can it be prevented?

_____

_____

_____

3. Think about the three types of food poisoning. How could these possibly occur in a restaurant? Choose one type of food poisoning to think about further, and answer the following questions.

Which type of food poisoning did you choose? _____

a. Write a food regulation for a restaurant that would help avoid this type of food poisoning.

_____

_____

_____

_____

_____

b. Explain why your regulation would be effective.

_____

_____

_____

_____

Discuss your answers with your learning facilitator.

Conclusion

In this section you have learned how the Canadian government sets food safety standards and enforces food regulations. You have learned how science helps to

- identify hazards
- make suggestions for new regulations
- investigate complaints

You have seen similarities between how you make decisions about your own food and how the government makes decisions about food for all of Canada.

Assignment Booklet

ASSIGNMENT

Turn to your Assignment Booklet and do the assignment for Section 5.

Note: After you have completed the assignment for Section 5, read the Module Summary which follows.

MODULE SUMMARY

At many different stages, foods can be contaminated by contact with micro-organisms: in soil; on human hands; on insects, rodents, or other pests; on unclean surfaces; in water; and in the air. Because of one form of spoilage or another, much of the food that is grown never reaches the stores.

By the time the food is in the store ready for you to buy, government standards, controls and inspections have prevented most serious problems. But food standards don't end there. Now your responsibility as the consumer begins. Do you know how to choose the best quality foods at the store? Do you know how to handle, cook, and store food safely? Do you know how to take care of various foods and what to do with leftovers? These are things you have thought about in this module and will need to think more about in years to come. This module will have given you a good start.

In this module you have learned about making decisions. Learning background scientific knowledge can be helpful to you in making good decisions not only about food but in many other areas as well.

Appendix

Glossary

Algae
- unicellular micro-organisms that are plants; the singular form is alga
  Most algae are green, red, or brown.

Bacteria
- one type of micro-organism that can be round, spiral, or rod shaped; the singular form is bacterium
  Some bacteria can cause disease while others are helpful.

Canning
- a method of preserving food by sealing it in airtight jars or cans

Chemical additive
- a substance made by people that is added to food to make it keep longer or look better; also referred to as an artificial additive

Consumer
- in biology, an organism that obtains its food by eating other organisms

Decay
- to become rotten

Decomposer
- an organism that obtains its food by breaking down wastes and dead materials

Federal
- central government of a country; the Government of Canada, located in Ottawa

Ferment
- a gradual chemical change in food caused by micro-organisms, such as yeast or bacteria, giving off bubbles of gas

Food poisoning
- several kinds of sickness caused by eating food containing certain kinds of harmful micro-organisms

Freeze-drying
- a method of drying frozen food under a high vacuum in order to preserve it

Fungi
- unicellular or multicellular micro-organisms that are plants; the singular form is fungus
  Fungi range in size from microscopic to the size of mushrooms.

Irradiation
- a food preserving method which uses radiation to kill micro-organisms in the food

Micro-organism
- an organism that is too small to be seen without a microscope

Microscope
- an instrument used to examine objects too small for the human eye to see clearly

Multicellular
- having more than one cell

Municipal
- dealing with local areas such as towns, cities, and municipalities

Perishable
- likely to spoil or decay

Photosynthesis
- a process in which food is made by using carbon dioxide from the air, nutrients from the soil, and energy from sunlight

Processing
- changing a material such as food from one form to another, often by cleaning, combining materials, and cooking

Producer
- in biology, an organism that makes (produces) its own food

Protozoa
- single-celled organisms larger than bacteria; singular form is protozoan
  Protozoa move by waving a whip-like structure, changing their shape, or beating hair-like structures.

Provincial
- belonging to a particular province rather than the whole country

Salmonella
- a type of bacteria that can cause food poisoning in humans

Spoil
- to become infected by decay or disease

Sterilized
- an object or substance that no longer contains any micro-organisms

Unicellular
- having one cell

Viruses
- extremely small organisms that grow and multiply only when in a living cell; the singular form is virus

Yeast
- a unicellular fungus that is used in making bread and alcohol

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